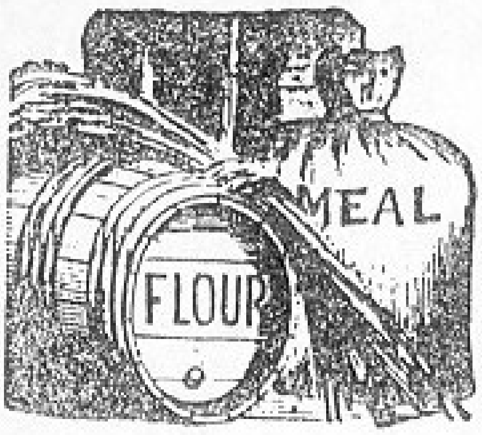
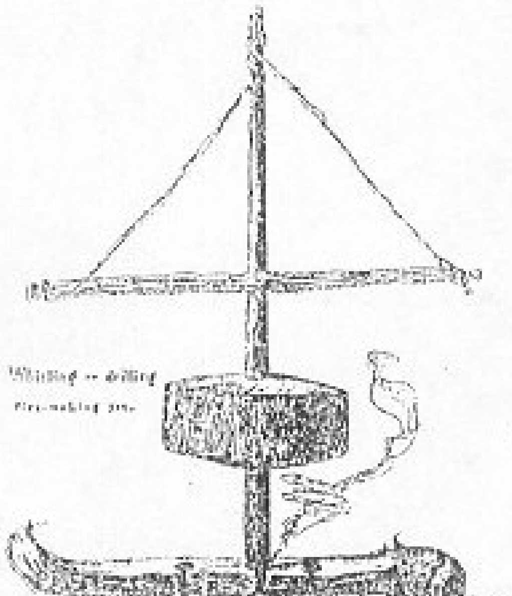
THE SURVIVOR

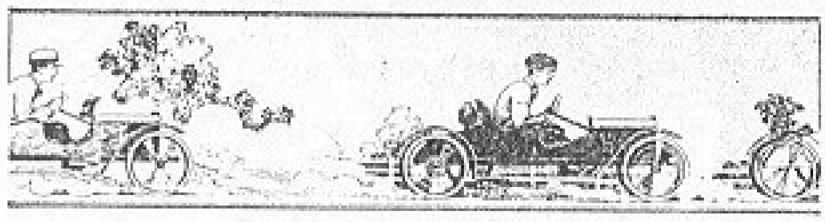
Volume 5 By Kurt Saxon





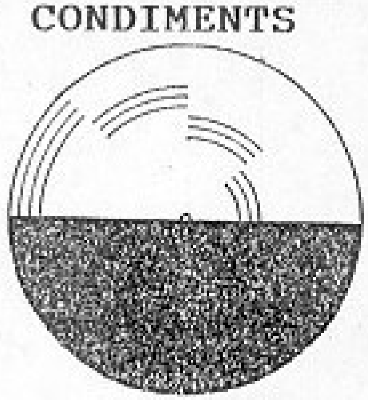
JUST A FEW OF THE ARTICLES IN VOLUME 5

MAKING ALCOHOL
HOME CHEMISTRY
WONDERS OF THE MICROSCOPE
PILE DRIVER
WATER POWER FROM STREAMS
PHOTO-ELECTRIC CELLS
HOMEMADE SEXTANT
SURVEYING
BIRD HOUSES
FIRE-MAKING
ENERGY FROM THE LENS
FOUNDRY WORK
VICTORY BARNYARD
1915 GLIDER
JAMS, PICKLES, CONDIMENTS



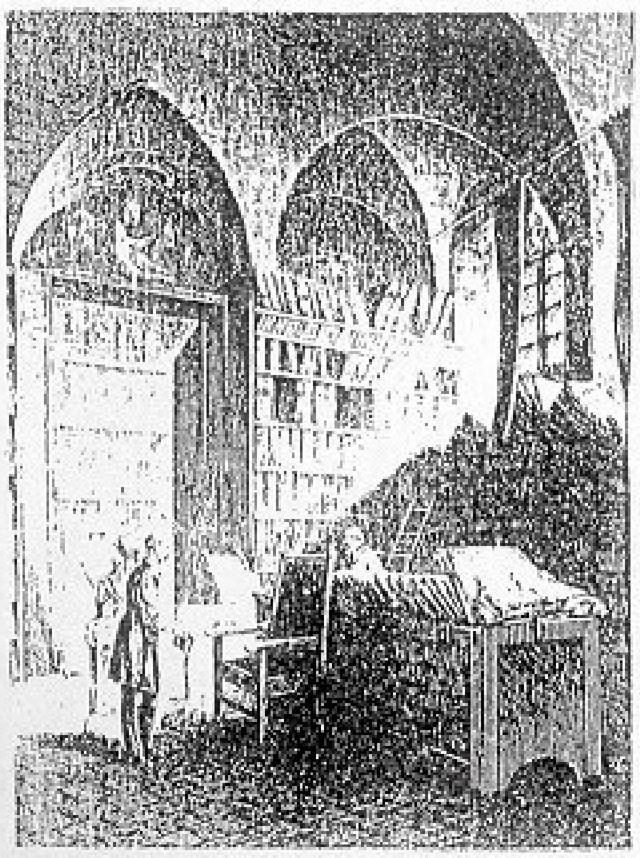
How to Make a Flymobile

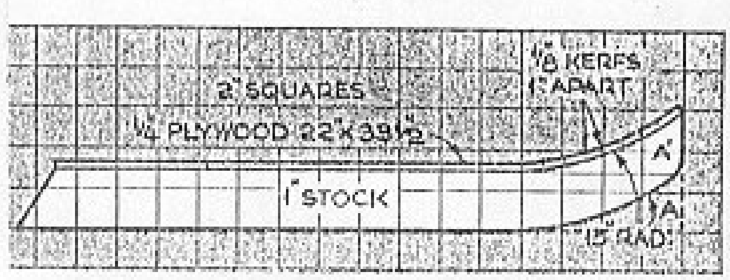
By EDWARD SIEJA



An Optical Top

From the Archives





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Volume 5

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THE SURVIVOR

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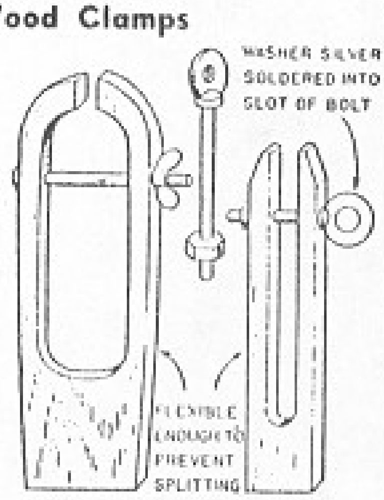
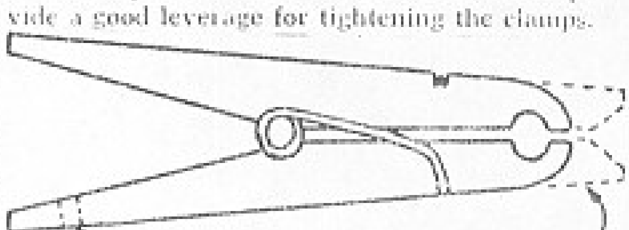
Wood Clamps



• If you need small wood clamps for gluing small parts, or for clamping pieces together while working on them, here are two simple methods for making them. You will find so many uses for these little clamps that you will want to make several in assorted styles and sizes.

Dick Hutchinson of San Gabriel, Calif., suggests that you shape them from $\frac{3}{4}$ in. oak on the jigsaw in any size desired and sand smooth (see drawing). Do not cut the two jaws too heavy—they should be thin enough to be slightly flexible, and the heel should be long enough to prevent them from splitting. For clamps 4 or 5 in. long make the sides about $\frac{3}{16}$ in. thick, and the heel about 1 to $1\frac{1}{4}$ in. long. Proportion other sizes accordingly.

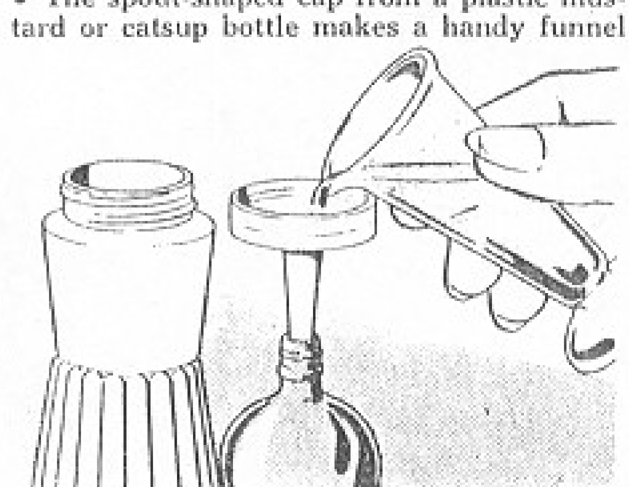
Taper clamp ends to a point, or round the ends as shown. Use bolts with wing nuts or, as in the case of the smaller clamps shown, solder washers into the eyes of filister head screws. These provide a good leverage for tightening the clamps.



Howard E. Moody of Upper Jay, N. Y., makes clamps for model work from wooden clip clothespins, cutting off the ends of the jaws to permit working close to the clamp.

Cap Funnels Liquid

• The spout-shaped cap from a plastic mustard or catsup bottle makes a handy funnel



for refilling bottles with small-diameter openings.

How Not to Survive

by Kurt Saxon

Six years ago when I began ***The Survivor*** there were only vague glimmerings of the worldwide disasters confronting mankind. As a historian, I could match the causes and effects which led to the downfall of past civilizations with the same degenerative influences dooming our own civilizations.

In the meantime, more and more people have at least awakened to the fact that the world is in terrible trouble. For the most part, however, they entertain themselves with the belief that wisdom will prevail; a leader is somewhere out there; the enemy will be exposed and destroyed, etc.. All such is merely wishful thinking. It is arrogance verging on paranoia to believe that our generation is somehow favored over, or superior to, peoples destroyed by the same causes throughout history.

Too many people, even survivalists, are unable to accept the end of world civilization. They mistake it for the end of the world, period.

The fall of Atlantis was the end of the last world civilization. It was such a shattering experience, and so complete that even most scholars consider Atlantis a myth. Yet it didn't mark the end of the world. Its totality lay in the fact that it was linked to, and interdependent with, all the other cultures on Earth, as in our present world civilization.

There were survivors of the fall of Ur of the Chaldees, Babylon, Greece and Egypt. But to the majority of their inhabitants it was indeed the end of the world.

Almost like Atlantis, the Roman Empire had spread a web of interdependence throughout Europe. Its fall was followed by hundreds of years of ignorance, misery, despotism, inquisition and degradation known as The Dark Ages. But it wasn't the end of the world.

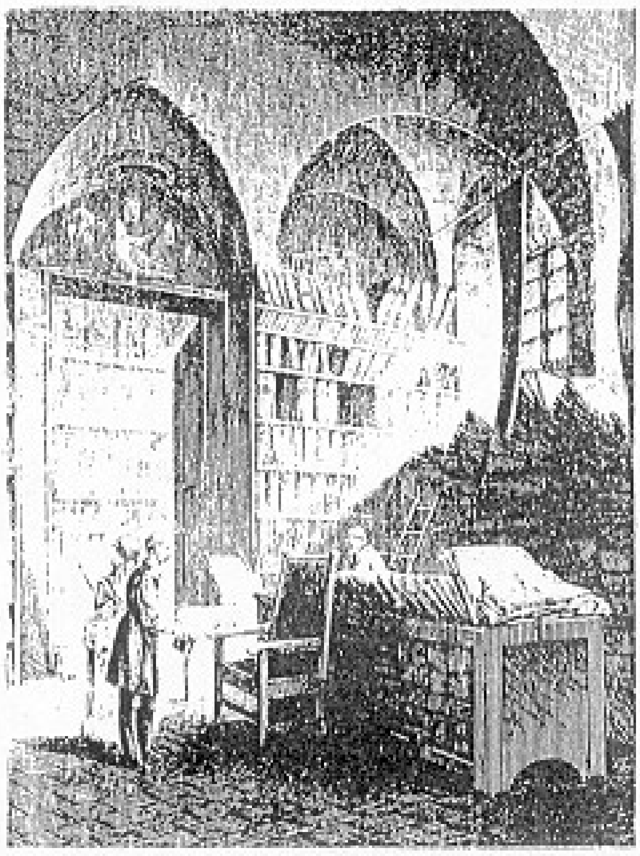
From 1348 to 1361 the Black Death engulfed Europe. One half of the British died while the rest of Europe suffered a loss of one fourth of its population. The plague ravaged the cities, for the most part, taking away the lower classes and leaving the aristocracy and the peasantry relatively safe.

Boccaccio's Decameron is a collection of stories supposedly told to each other by a group of affluent and intelligent Florentines. During the plague they left the stricken Florence for the countryside and partied and told witty stories until the worst was over.

It wasn't the end of their world. When the plague died out they went back. Since the working class was decimated the survivors had to set about replacing hands with machines. Technology and science bloomed and the period was called "The Renaissance" or rebirth.

So accept the end of world civilization with hope that you won't

From the Archives



From The Archives

Here is a selection from 19th Century Harper's Monthlies. They are various entries in the science sections which are thought provoking and sometimes clever. There might be an idea here, dropped back then, but worthy of reconsideration.

IS THE BRAIN A GALVANIC BATTERY ?

Among the supposed facts relied upon to prove that the animal brain is a battery, which can send currents of electricity through the nerves so as to act upon the muscles, is an experiment referred to by Mr. C. F. Varley, in a late article, which consists in connecting the two terminals of a very sensitive galvanometer with separate basins of water. If a hand be placed in each basin, and one be squeezed violently, a positive current is said generally to flow from that hand through the galvanometer to the other hand, which is not compressed. Mr. Varley, however, after various experiments, has come to the conclusion that the phenomenon is due to chemical action alone, the act of squeezing the hand violently forcing some of the perspiration out of the pores. This is proved by the fact that when both hands were placed in the water, and a little acid was dropped on one of them, a current was generated without any muscular exertion. Mr. Varley found nothing to show that electricity exists in the human body, either as a source of motive power or otherwise, and he considers the feeble electricity obtained from the muscles to be due to the different chemical conditions of different portions of the muscles themselves. As the force transmitted by the nerves is at a rate about 200,000 times slower than an electric current, he infers that it can not be an electric current itself.

INHALATION OF DUST BY WORKMEN.

The injurious effect of exposure to the dust of various manufacturing establishments has not unfrequently been dwelt upon with more or less force; but we are hardly prepared for the result of certain specific investigations on this subject. It has long been a disputed point whether the particles of iron, silica, etc., merely lodge within the air-cells of the lungs, or penetrate through

necessarily go with it. Having done this, you can see the absurdity of the following stopgap measures to survive a temporary calamity.

Investing in intangibles: Gold, silver, diamonds, antiques, paintings, etc. are dependent for their value on desire, not need. When need is the uppermost consideration, desire is simply a frivolous emotion. In order to exchange your intangibles for your needs you will have to wait until surplusses are built up. In the meantime, say you approach a farmer and offer him a $600 Krugerand for its value in chickens. If you're lucky he may offer you a $600 chicken.

Bugout vehicles: I'm amused by the fantasies of urban types who stock a camper with everything one could possibly need to survive. When it hits the fan they will leave just before the rioting gets too fierce or the mushroom cloud hovers directly overhead.

Roads blocked by fuelless and/or wrecked vehicles will doom most bugouters. Bandits will account for many who make it past the congestion.

People in the rural areas, threatened by mobs of refugees, will shoot at anyone who doesn't keep moving. You can't carry enough gas to keep moving.

It will take weeks, maybe months, for rurals to run out of supplies in their villages and towns. Turning away strangers as a matter of course, there is little chance that you'd be allowed to settle among them before your own supplies ran out, regardless of what you had to barter.

Best to pack a U-Haul and move to the Ozarks now.

Fallout Shelters: These are for urban areas. Business executives locked into the establishment figure they can submerge before the fallout chokes them. After a couple of weeks they seem to expect to come out to some kind of brave new world, go back to their desks and carry on as usual.

When the cities go, those trapped in shelters will share the fate of those without shelters. A chance for a couple of weeks of life is not worth the expense.

In the fifties shelters would have been practical in the event of a nuclear war. But in the eighties the devastation will be so much greater that rebuilding on nuclear ruins will be unthinkable for years.

Outside the major cities a shelter might be nice and a real protection against the worst of the fallout. Even so, it would be with us for months, if not years.

Hiroshima and Nagasaki have proven the fallacy of mutations and obliteration by radiation sickness, sterilization and cancer years later. But the majority will survive without shelters, unless all life is destroyed.

Arsenals: I love guns, but I have only enough for myself. I won't have to arm my neighbors because I've never met anyone here who isn't well armed.

I have a complete reloading setup, accommodating every rifle, shotgun size and pistol of the common variety. Forget the exotic stuff. I'm prepared to reload for the community. That's all that's needed.

Yet I read of gun nuts buying everything that will shoot as if guns were all that mattered. They must think the shooting will go on and on for years.

Maybe they're right if they get trapped between the big cities and the well defended rural areas. In that case the gun nuts would become precisely what they fancy they are arming against.

their walls into the tissue between them. But Professor Zenker informs us that, on examining the lung of a woman who had been exposed to the dust of iron oxide, used in preparing books of gold-leaf, he found the powder in the tissue between the air-cells and in their walls, as well as in their cavities. From less than two ounces of this lung over twelve grains of iron oxide were obtained by chemical methods; so that, if equally distributed through both lungs, there must have been at least three-quarters of an ounce inhaled. In another case—that of a workman exposed to the dust of a mixture used in preparing ultramarine substances—he found a quantity estimated at fully an ounce.

RUSTING OF IRON.

Professor Calvert, after repeated experiments, has found that pure dry oxygen does not determine the oxidation of iron, and that moist oxygen has but feeble action; also that dry or moist pure carbonic acid has no action, but that when moist oxygen containing traces of carbonic acid is brought into contact with iron, the latter rusts with great rapidity. He concludes, therefore, that carbonic acid is the agent which determines the oxidation of iron, and that it is the presence of carbonic acid in the atmosphere, and not its oxygen or its watery vapor, that produces the oxidation of iron exposed to common air. In one experiment he found that if clean blades of the best quality of iron be placed in water which has been well boiled, and deprived of its oxygen and carbonic acid, they will not rust for several weeks; and that if a similar blade be half immersed in a bottle containing equal volumes of pure distilled water and oxygen, the portion dipping in the water becomes rapidly oxidized, while the upper portion remains unaltered. But if to the atmosphere be added some carbonic acid, chemical reaction on the exposed portion, with rapid oxidation, takes place immediately.

In reference to the fact, first published by Berzelius, that caustic alkalies prevent the oxidation of iron, he remarks, as the result of special experiments on this subject, that the carbonates and bicarbonates of the alkalies possess the same property as their hydrates; and that if an iron blade be half immersed in a solution of such carbonates, they exercise such a preservative influence on that portion of the bar which is exposed to the atmosphere or common air (oxygen and carbonic acid) that it does not oxidize even after a period of two years.

RENDERING WALLS WATER-TIGHT.

It is proposed by Mr. F. Ransome, of London, to render stone and brick walls water-proof by coating them to saturation with a solution of silicate of soda, which is superficially decomposed by the farther application of chloride of calcium. The surface thus obtained consists of silicate of lime, which is perfectly insoluble, while it does not alter the appearance of the wall.

MANUFACTURE OF WOOD PULP FOR PAPER.

Among the more interesting articles at the International Exhibition in London, in the summer of 1872, was a series of illustrations of the process devised by Mr. Houghton for converting wood into pulp for paper. It is said that the difficulty hitherto in using this material for the purpose mentioned has been the necessity of using such large quantities of alkali as to make the cost of the operation too great to be generally employed, at least abroad. This difficulty has been overcome by Mr. Houghton's process, and it is expected that large quantities of wood, heretofore wasted, will be made available. Every saw-mill in the United States has an immense amount of refuse material, which it is extremely difficult to get rid of, and in many instances large fires are kept burning night and day in order to destroy it. There will be nothing in the way, it is said, of treating this refuse so as to have it rendered available for paper-making, and thus, while utilizing an immense amount of waste material, to cheapen the cost of books and newspapers.

In the process of Mr. Houghton, in the first place, the wood is cut diagonally by a series of knives, so that the fibre easily separates by the splitting of the grain. These slices are again broken in smaller pieces, furnishing the raw material for the next manipulation. This consists in introducing them into a patent boiler calculated to endure great pressure, and heated by hot water circulating in pipes which traverse it in sections throughout its length, the heat being capable of most accurate regulation.

The pressure employed in the process of treating the fibre is 180 degrees, and the wood is introduced into the boiler in wire cages running

So unless you're a gunsmith or an honest collector, you have no reason to collect guns just for the sake of having them. Best to spend your money on more useful items.

Of course, you should have a good shotgun, rifle and pistol. You ought to get a copy of Mel Tappan's book, SURVIVAL GUNS and choose the best guns you can afford and in the variety which will suit your actual needs. But to consider an arsenal more important than long-term survival tools is juvenile.

Fighting Communism: With actual Marxist Communism on the wane, the money and effort expended in fighting that silly idiology is a waste. Of course the term "Communism" is becoming increasingly replaced by "Bildebergers", "Trilateralism", etc. which is supposedly the same thing. It seems that everything is part of a huge plot. Belief in such a plot is commonly known as "The Conspiricy Theory".

Communists, Bildebergers, Trilateralists and perhaps a dozen other vague groups are being given credit for just about everything wrong on our planet. If a culprit could be found, identified, fought and thereby stopped, the whole "fight" would be reasonable. But this nonsense has been going on for years with nothing to show for all the exposures by all the "patriots" we have left.

When Rome was surrounded by barbarians and wracked with rioting by proletarions and freed slaves the rightious citizens wasted valuable time following up their own conspiricy theories. Rome fell without any of the "conspirators" being bothered.

The point is that degeneration doesn't need any particular label and labeling it only gives false hope that a label is somehow like a target one can shoot at. This is a false comfort since the target itself is false.

Political and international manipulation of the world's inferiors should be ignored at this time. The better prepared you are to handle your own problems, the better able you will be to deal with the vermin when the collapse comes. In the meantime, don't jeopardize your efforts toward survival by getting upset over what a pack of doomed parasitical predators are up to.

REVOLT AGAINST CIVILIZATION, by Lothrop Stoddard is being serialized in U.S. MILITIA. It shows how communists are simply intelligent but warped losers stirring up feeble minded losers against their betters.

As far as I'm concerned, the losers have taken the world's cities and destroyed its economies. Let them have the cities. Most of them will die there.

The only way to fight losers is by abortion and sterilization. Waiting for them to arm themselves and then trying to combat them is a bit late. Since its too late, anyway, give them this round. Move from the cities and let them rot. After the worst is over we survivalists can destroy what's left of them at our leisure.

upon a set of rails, the small pieces after boiling being quite soft and of a dingy color. This is next treated by means of chlorine in a vat, and the bleaching finished by the use of permanganate of potash. The material is now a soft, pulpy, and highly fibrous substance, which is next subjected to the action of a hydro-extractor, a kind of wringer, which leaves it in the shape of a damp, fleecy mass.

The liquid with which the fibre has been treated is then pumped into a vat, and subjected to the action of carbonic acid gas, which solidifies to some extent the resinous particles. It is next placed in a copper boiler, and heated exactly to the boiling-point. This produces a complete coagulation of the resin, which falls to the bottom in large flakes. No use has been, so far, found for this resin, but it is expected that before long it may become of commercial value. There are many other details in the manipulation of the fibre, for which reference must be made to the technical journals.

THE ELECTRIC PHENOMENA OF CRYSTALS.

The electrical phenomena developed in many crystals by heating or cooling them has not been thoroughly pursued since the early studies of Sir David Brewster until the recent investigations of Hankel of Leipsic. The elaborate researches of this eminent physicist have opened up new views of the subject, and will undoubtedly contribute to place upon a more correct basis our knowledge of the relations between heat, electricity, and crystalline structure. Hankel has stated some of his conclusions very nearly as follows: "Up to the time of my researches on the thermo-electric peculiarities of topaz we knew only of the electric phenomena of crystals having electrically polar axes—that is, of those of which one end showed positive, the other negative electricity; and this seemed to be a physical necessity, so that it was concluded that there existed the possibility of thermo-electric excitation if the crystal was hemimorphous, and if pieces of crystals showed a thermo-electric tension it was concluded that the perfect crystal would be hemimorphous. My studies upon many varieties of crystals show that this idea is wholly unfounded, and rather is it true that the thermo-electric excitation is a general property of all crystals, at least those in which other properties render it not impossible, and that if the tension were not too feeble to be measured by our instruments, it would always be discovered."

The observations of the distribution of electricity, both in the perfect and in the broken crystals, force us to modify our former views as to the nature of crystals in general. Until now certainly all mineralogists and physicists have assumed that if a crystal be broken or cloven, then all physical peculiarities, except the exterior form, are to be found in the separate pieces as in the original crystal, and that, therefore, the pieces are in these respects similar to each other; and, indeed, the optical and thermal properties do not allow us to detect any differences in this respect. On the other hand, the thermo-electric phenomena show that this view can not be maintained intact. We must now consider the crystal as a complete individual in itself, in which, as in the organic individual, the respective parts do not resemble each other or the whole, though the exterior form of the parts and the whole may be perfectly similar.

PRESCRIBED DYES FOR CANDIES.

A police regulation has been recently established in some parts of Germany prescribing the substances that may be used for coloring candies and other edible articles. The variety is very

Easily Built

Radio Burglar Alarm With Receiver Parts

Novel Circuit Resembling One-Tube Set Literally "Feels" Presence of Intruders and Sounds Warn

By J.B. Carter
Popular Science Monthly
January 1936

The front door can be protected by fastening the detector wire to the lock. Anyone approaching the lock sets off the alarm

NEITHER craftiness, jimmies, nor gum-soled shoes will help the prowler who tries to enter a home protected by this novel radio burglar-alarm system. He may not pick a lock nor force a window, yet his unwanted presence will trip the sensitive circuit that sounds the alarm.

Operating on radio-receiver principles, the circuit is as easy to construct as the simplest one-tube set. In fact, its type '76 tube, plug-in coils, and variable condensers make the completed outfit look very much like a small short-wave receiver. The parts, all standard, can be purchased from any radio dealer for a total of about seven dollars.

In use, the alarm system consists of three units—an electric vacuum-tube circuit and relay, a battery-operated gong or bell, and a concealed detector wire. The actual circuit, housed in an aluminum cabinet, can be hidden in a drawer or closet. Only one thing determines its location; it must be near an electric outlet, since it is operated by 110 volts either direct or alternating current. The alarm gong can be installed almost anywhere, preferably at some distance from a window or outside door.

In placing the detector wire, the home owner will have to use ingenuity. Where it is placed will depend to a great extent on the construction of the house. The obvious points of entry should be protected. It can be concealed around windows and doorways, connected to the front-door lock, or wired to a rectangle of wire screening concealed under a rug or front-door mat.

Since the alarm will be sounded when anyone approaches within a few feet of the detector wire, it can be completely concealed in the woodwork or under rugs, upholstery, and tapestries. Once the experimenter understands the inner workings of the circuit, he should have little difficulty in placing the detector wire to best advantage.

First of all, the type '76 tube is the key to the circuit. Connected as shown

great, and would seem to meet all necessary requirements. All the aniline colors, without exception, are prohibited.

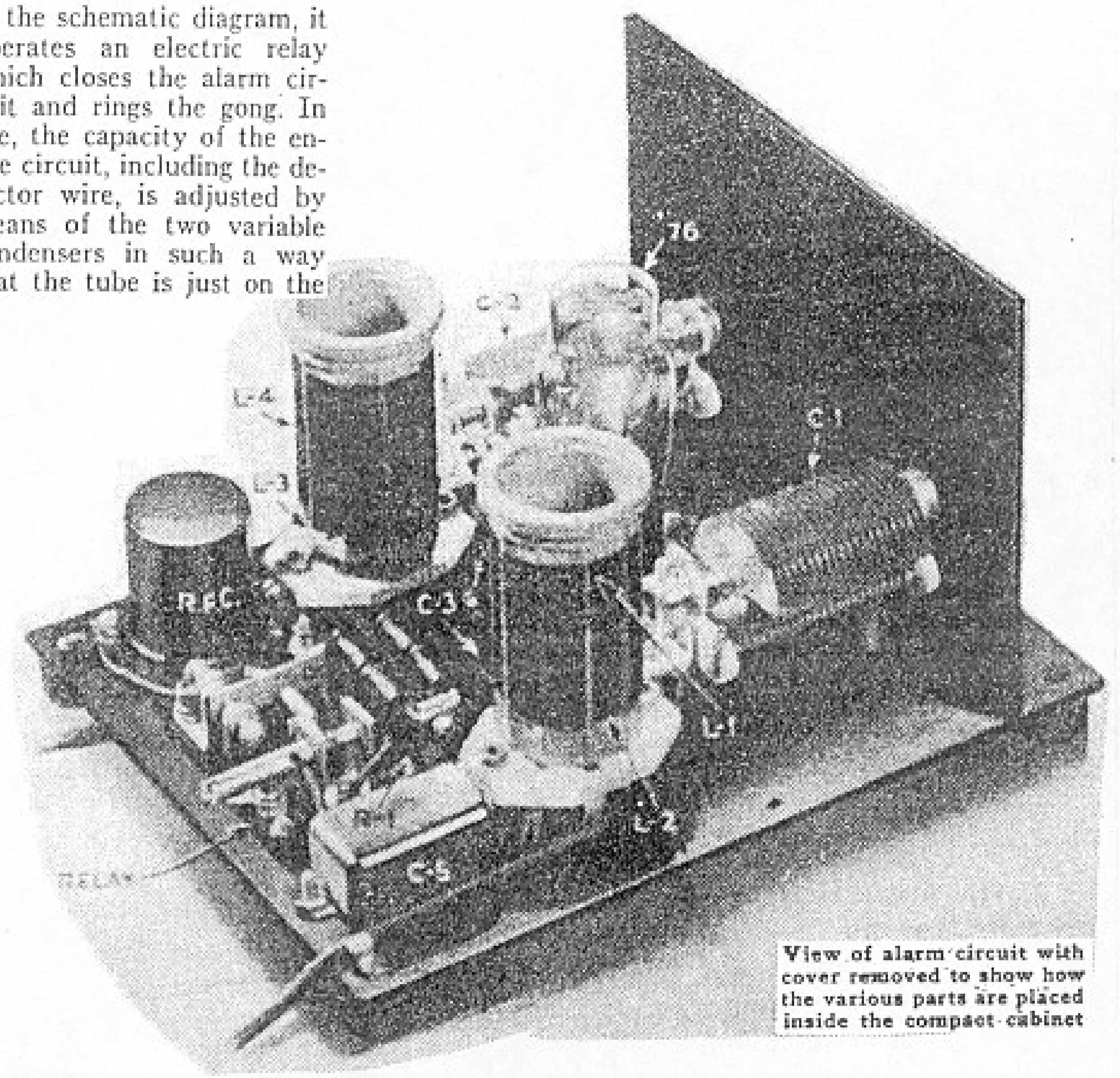
REMOVING THE ODOR OF CARBOLIC ACID.

The value of carbolic acid for many applications is now well established, but for medical purposes is greatly diminished by the odor, which is extremely offensive to many persons. It may, therefore, be interesting to know of a method which, according to Professor Church, will entirely remove this odor, substituting for it a delicate trace of geranium leaves, which may, perhaps, be improved upon by adding a few drops of that oil. The process, as recently published by Mr. Church, consists in pouring one pound of the best carbolic acid of commerce (the white crystallized) into two gallons of cold distilled water, taking care not to permit the *whole* of the acid to enter into solution. With a good sample, if, after shaking repeatedly at intervals, between two and three ounces of the acid remains at the bottom of the vessel used, this will be a sufficient residue to hold and contain all the impurities: with bad samples, less water must be used, and more acid. The watery solution is to be siphoned off, and filtered, if necessary, through fine filter-paper till perfectly clear. It is then placed in a tall cylinder, and pure powdered common salt added, with constant agitation, till it no longer dissolves. On standing for a time, the greater part of the carbolic acid will be found floating as a yellow oily layer on the top of the saline liquor, and merely requires to be removed to be ready for use. As it contains five per cent. or more of water, it does not generally crystallize, but it may be made to do so by distilling it from a little lime. The portion collected, up to about 365° F., has, at ordinary temperatures, scarcely any odor save a faint one resembling that of geranium leaves. The addition of about four drops per fluid ounce of the French oil of geranium will still further mask the slight odor of the acid, and has an additional advantage of liquefying the pure crystallized product. The pure acid may be dissolved in 230 parts of water, and used as a gargle, or in 25 parts of water for painting the throat, or in 50 parts for the carbolic spray.

BLOW-PIPE FURNACE.

A simple and convenient arrangement for the purpose of producing heat more than equal to the melting of cast iron by means of the gas blow-pipe consists of a furnace composed of two parts—an interior envelope and a movable covering. The latter, which completely surrounds the internal portion, rests upon a flange adapted to the outside and lower extremity of the interior envelope. Its walls are very thick, the better to retain the heat, and upon its lower edge eight holes are symmetrically placed, to allow an outward passage to the heated gases. A knob or ring of iron at the top serves to remove and replace the covering. The crucible to be heated is held in the centre of the interior portion by a platinum support, which rests upon a small ledge. The source of heat (an ordinary gas blow-pipe) is arranged beneath so that the nozzle shall be only an inch or so below the inferior circular orifice; the flame will therefore circulate, in the first instance, round the crucible, then in the annular space between the interior envelope and the covering, and the products of combustion will finally pass out through the eight openings at the base. The progress of the heating may be noticed by holding a small mirror beneath. With a furnace arranged in this manner persons have succeeded in melting six hundred grains of cast iron in a small porcelain crucible in less than a quarter of an hour.

in the schematic diagram, it operates an electric relay which closes the alarm circuit and rings the gong. In use, the capacity of the entire circuit, including the detector wire, is adjusted by means of the two variable condensers in such a way that the tube is just on the



View of alarm circuit with cover removed to show how the various parts are placed inside the compact cabinet

verge of oscillating. So long as the circuit remains in that condition, the relay remains open. Now, suppose a burglar enters through a doorway or window protected by the circuit. To do so he must come within a few feet of the detector wire concealed in the woodwork. His presence near the wire adds more capacity to the circuit, upsets the sensitive balance, and immediately the tube begins oscillating. This in turn cuts off the current to the relay, closes the gong circuit, and rings the alarm bell.

Technically, this is what takes place: During one half of each cycle, the oscillations cause electrons, tiny particles of negative electricity, to accumulate on the grid of the tube and on one plate of the grid condenser ((C3). During the next half cycle, the oscillation is reversed, but the electrons already accumulated on the grid are trapped and cannot escape.

This is repeated with each successive cycle and as the accumulation of electrons (negative electricity) increases, the voltage of the grid becomes more and more negative. Eventually, the grid of the tube becomes so heavily loaded with the negative charge that the positive voltage on the plate is neutralized and the plate current drops to zero. This cuts the current off from the relay, deenergizes the magnets which release the relay armature, and allows it to close the battery circuit to the gong. This, of course, all takes place very rapidly, the actual time required being less than one ten thousandth of a second.

Since the operation of the circuit depends entirely on balance, it is obvious that good insulation and low-loss construction are important. The sockets used for the tube and coils particularly must be of the heavily insulated type. Likewise, the condenser should be of the variety mounted on slabs of low-loss insulating material. Under no circumstances alter any of the specifications. They were chosen only after several months of experimentation.

The alarm circuit, with its dustproof cover and two control knobs, looks like a receiver

The two coils required are of the standard six-prong, plug-in type having three windings on each form. As only two windings are required on each coil, the tickler can be removed from one and the primary winding from the other. The remaining windings are indicated on the

BORAX FOR EXTERMINATING COCKROACHES, ETC.

Among the many applications of borax recently made, one of the latest is in the extermination of cockroaches, which purpose it is said to answer very perfectly, although we are inclined to doubt it. Half a pound, finely pulverized and scattered about where these disagreeable pests frequent, will, it is said, clear an infested house so thoroughly that the appearance of one in a month is quite a novelty. It is not known upon what peculiar influence of the borax this depends; but we are assured that the facts are as stated. One advantage of this application is the harmless nature of the borax, so that there is no danger to the household from its being exposed. The use of borax, in Europe, for washing, is well known, the addition of a large handful of borax, instead of soda, to ten gallons of water, being sufficient to save half the quantity of soap ordinarily required. For light fabrics and cambrics a moderate quantity is to be used; but for crinolines, which require to be made stiff, a strengthened solution is necessary. Being a neutral salt, it does not affect the texture of linen in the slightest degree; and as it softens the hardest water, it is much used in washing generally. It is also said to be unsurpassed for cleaning the hair.

COPYING PICTURES BY COLLODION.

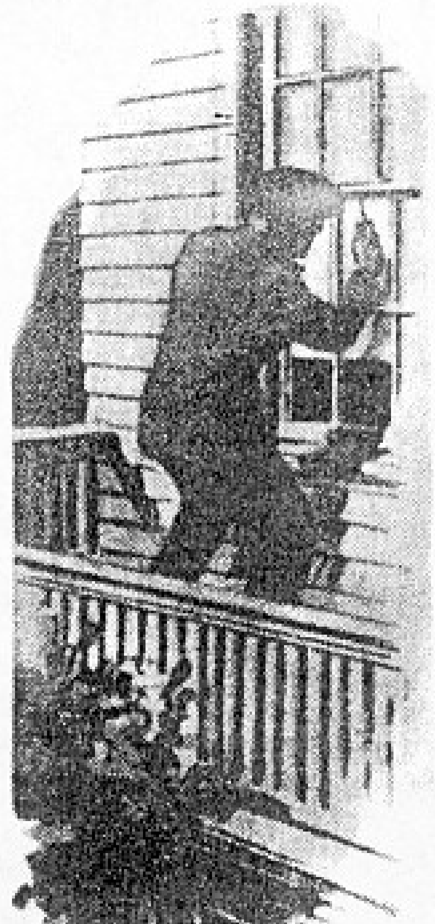
According to Mr. Kleffel, if a glass plate be coated with collodion in the ordinary manner, and, after the liquid has set, a piece of printed paper be pressed lightly upon the surface by the hand, a very exact reproduction of the letters or figures will be found impressed upon the collodion when the paper is removed, the design remaining perfectly visible after the complete drying of the film. It is suggested that this may be the germ of some important applications in the way of the reproduction of printed matter, without injury to the original.

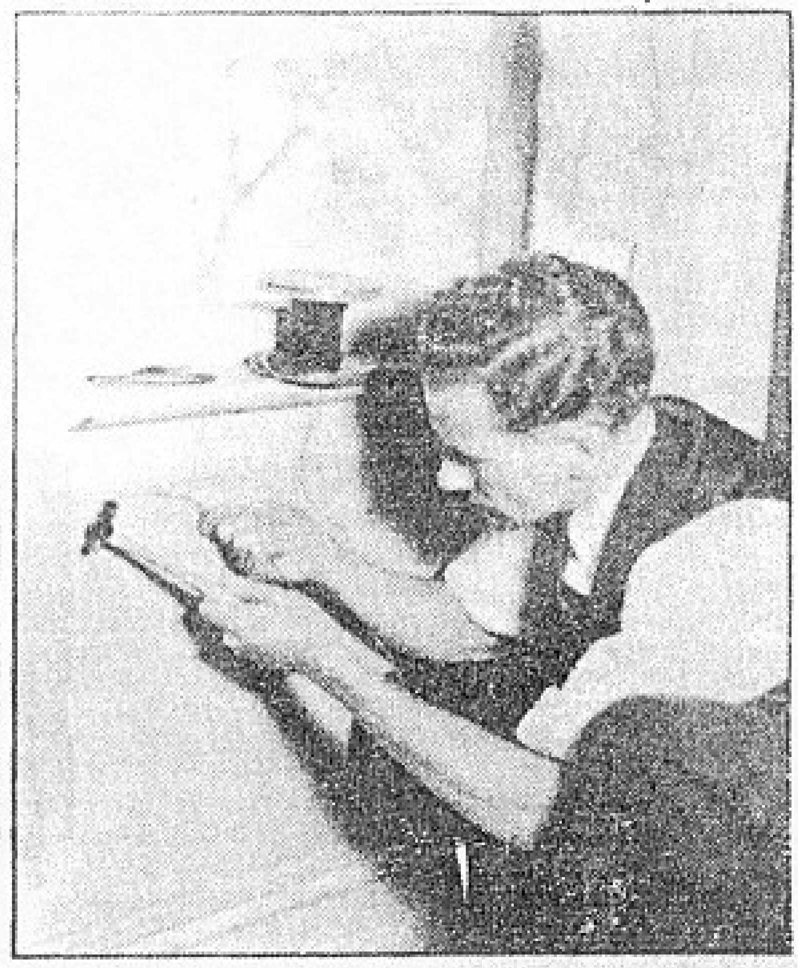
CURE OF FLATULENCY.

A writer in the *English Mechanic*, in treating of the not unimportant subject of flatulency, says that of this there are two kinds. In health the stomach and intestines always contain a moderate quantity of gas that is nearly pure nitrogen. This appears to be secreted by the mucous membrane of the stomach and intestines, and, in excessive amount, is one of the most troublesome kinds of flatulence. The other kind arises from fermentation or putrefactive change of the food, and contains carbonic acid, and sometimes sulphureted hydrogen, as well as nitrogen. Both these forms of flatulence are best treated by using pure vegetable charcoal finely powdered—taken in the first case with each meal, and in the second as soon as the symptoms appear. The dose may be a tea-spoonful, and its use should be continued for some time. This will usually correct constipation as well as looseness of the bowels, besides relieving the disease itself.

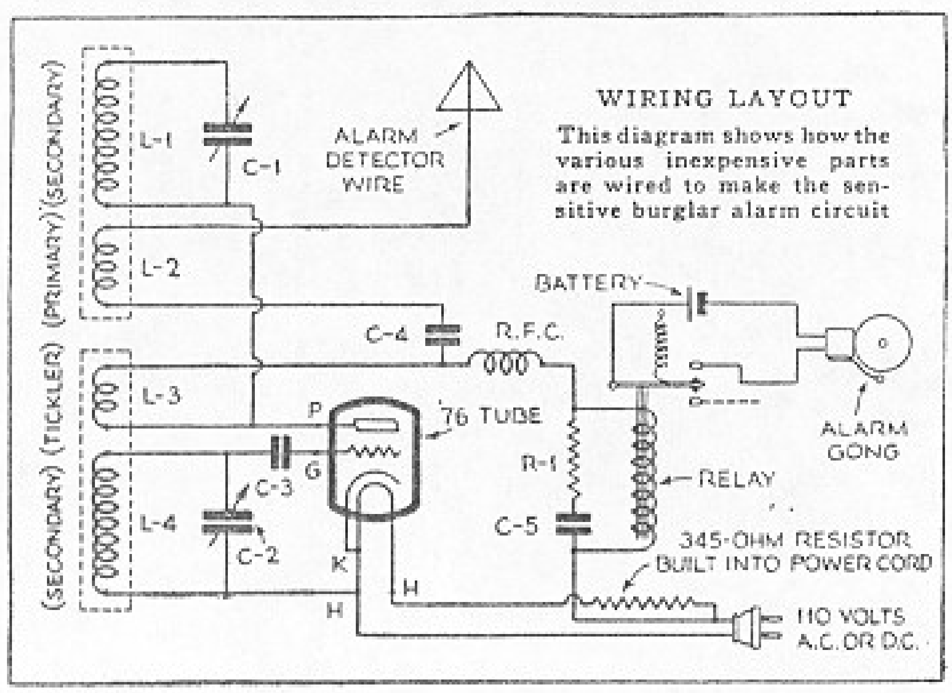
FREEZING OF WATER.

In a recent communication to the Academy of Sciences of Paris M. Boussingault described some experiments showing that water is not liable to freeze, irrespective of the degree of cold to which it is submitted, as long as it is not allowed to expand in order to change into ice. In one instance water inclosed in a strong steel tube was exposed to a temperature of $-13°$ Centigrade without congelation. This, however, occurred instantaneously on unscrewing the steel end of the tube. The fluidity of the water was made manifest by small steel spheres which moved freely inside of the tube during the whole process, and would have been stopped by congelation.





When the detector wire is strung around a window, as shown, any intruder sets off the alarm



WIRING LAYOUT

This diagram shows how the various inexpensive parts are wired to make the sensitive burglar alarm circuit

diagram. Since the primary and tickler coils in each case are silk-covered wire, they can be identified easily.

A good grade of mica condenser should be used for the grid condenser(C3). Its outer covering should be well insulated.

Any sensitive relay that will operate between one and ten milliamperes current can be used as the control unit in the system. By shopping around, relays of this type can be obtained for less than a dollar.

Although the placement of parts and general layout of the circuit is not critical, the experimenter, particularly the novice, should not attempt any radical changes. In the original, the base and front panel were cut from sheet composition although a baseboard of wood would have served equally well. Since the circuit must be stable, it is important that all parts be mounted rigidly to prevent shifting.

Wiring throughout should be from point to point and heavy, solid bus-bar wire is preferable to flexible wire. Make good firm soldered connections and pay particular attention to the soldered connections in the tuned circuit. Any resistance introduced here will result in a loss of sensitivity.

TO TEST the alarm, adjust both tuning condensers for minimum capacity and grasp the detector wire in your hand. Rotate the tuning condenser C1 slowly until the relay deënergizes. A click will be heard when this takes place, indicating that the spring has pulled the armature over to the contact that closes the gong circuit. Finally, turn the condenser back

EUCALYPTUS A FEBRIFUGE.

The cultivation of the *Eucalyptus globulus* is making rapid progress in the south of France, Spain, Algiers, and Corsica, especially on account of its alleged virtues as a remedy for fever. It furnishes a peculiar extractive matter, or alkaloid, called eucalyptine, said by some to be as excellent a remedy against fever as quinine. In Spain its efficacy in cases of intermittent and marsh fevers has gained for it the name of "fever-tree." It is a powerful tonic and diffusible stimulant, performs remarkable cures in cases of chronic catarrh and dyspepsia, is an excellent antiseptic application to wounds, and tans the skins of dead animals, giving the fragrance of Russia leather. The tree prefers a marshy soil, in which it grows to a great height very rapidly. It dries the earth under it by the evaporation from its leaves, and shelters it from the sun, thus preventing the generation of marsh miasm.

MR. WILLIAM THOMPSON ON DARWINIANISM.

Mr. William Thompson, in his address before the British Association at Edinburgh, takes occasion to give in his adhesion to the Darwinian views of evolution, and not only expresses his belief that all the higher organisms now covering the face of the earth have most probably developed themselves from lower ones, but suggests also that these were most likely derived from meteoric stones and other matter fallen from the planets.

ACTION OF ANÆSTHETICS ON THE NERVOUS CENTRES.

M. Prevost, in the course of some experiments in reference to the mode of action of anæsthetics and chloroform upon the nervous centres, has reached conclusions quite different from those of Claude Bernard. This physiologist asserts that chloroform, in acting upon the brain, causes anæsthesia not only in this organ, but acts also at a distance upon the spinal marrow, without being in contact with it.

M. Prevost has repeated the principal experiments of Bernard, which consisted in stopping the circulation of the blood in frogs by a ligature beneath the axillæ, then injecting chloroformed water—in some beneath the skin of the anterior portion of the trunk, and in others beneath the skin of the posterior portion. By varying the position of the frogs in these experiments, Prevost found, contrary to the opinion of Bernard, that chloroform introduced into the hind quarters produced anæsthesia in the anterior when the frog is placed with the posterior limbs in the air; while chloroform introduced into the fore quarters does not produce anæsthesia in the hinder if care has been taken to place the frog with the head downward. He thinks, therefore, that M. Bernard has not been sufficiently guarded against the filtration of chloroform across the tissues.

Upon applying pure chloroform upon the denuded brain of a frog, the aorta of which had been tied, and the animal placed in the position indicated above, M. Prevost has produced anæsthesia in the head of the animal alone, leaving the functions of the spinal marrow unaffected. But upon subsequently untying the aorta, the frog returned to the normal condition, which proves that the chloroform in this experiment has acted only as a simple anæsthetic, and not as a caustic, which destroys the brain, leaving the frog in the condition of a decapitated animal. M. Prevost, therefore, thinks he is entitled to conclude from his experiments that chloroform produces anæsthesia in the nervous centres only in the portions with which it is directly in contact, and that it does not act at a distance, as M. Bernard supposed.

a bit and repeat the process. The two condensers should be so set that the relay just trips when your hand is brought near the detector wire.

If a 0 to 10 milliammeter is available, extremely fine tuning can be obtained. With the meter inserted in the plate lead the condensers should be adjusted to give the lowest possible reading without tripping the relay. With either method, a certain amount of experimenting will be necessary to balance the circuit at such a point that a hand brought within a few feet of the detector wire will sound the alarm. The best adjustment will be quite critical, due to the extreme sensitivity of the circuit.

Naturally, as with any burglar alarm, periodic inspections and tests should be made to check the sensitivity. Should the circuit get out of order or the power fail, however, the alarm will sound automatically. It likewise will sound if the burglar cuts the power lines or, on finding the control circuit, removes the power plug from the wall socket.

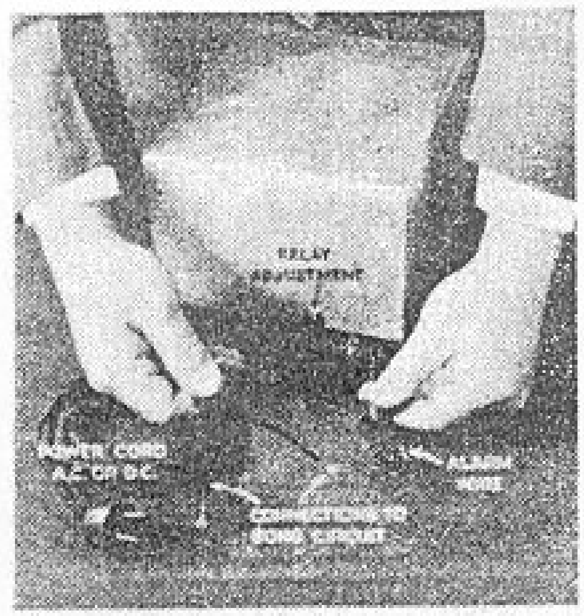
Although the alarm can be turned on and shut off simply by inserting or removing the power plug and connecting or disconnecting the bell, control switches installed in the power-cord lead and alarm-bell circuit will make it easier to shut the system off during the day and turn it on at night.

Because of its novelty, the circuit can be put to many other uses. For instance, it can be used to turn on the lights when you enter your front hall. It can be rigged to open doors, operate drinking fountains, indicate rain, operate toys and window displays, and do a score of other things. Of course, where 110 volts are used in the circuit being controlled, a relay rated to carry that amount of current must be used.

LIST OF PARTS

C_1 and C_2.—Variable condensers, 325 mmf.
C_3.—Fixed mica condenser, .0001 mfd.
C_4.—Fixed paper condenser, .06 mfd.
C_5.—Fixed paper condenser, .5 mfd.
R_1.—Fixed resistor, 10,000 ohm.
R. F. C.—Radio-frequency choke, 85 mh.

Miscellaneous: Two six-prong, 160-meter plug-in coils; two six-hole sockets; one five-prong socket; one power cord with built-in resistor (345 ohm); type '76 tube; one battery and gong or bell for external alarm circuit; one sensitive relay; wire; solder; chassis; panel; knobs; etc.

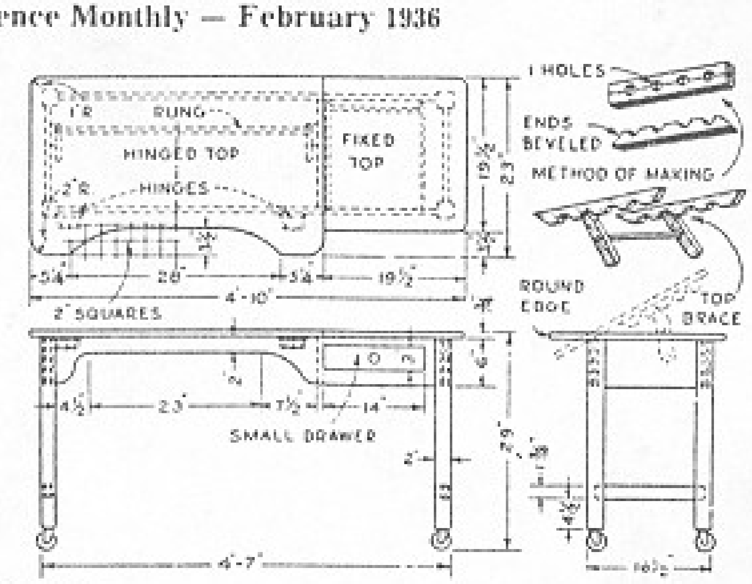


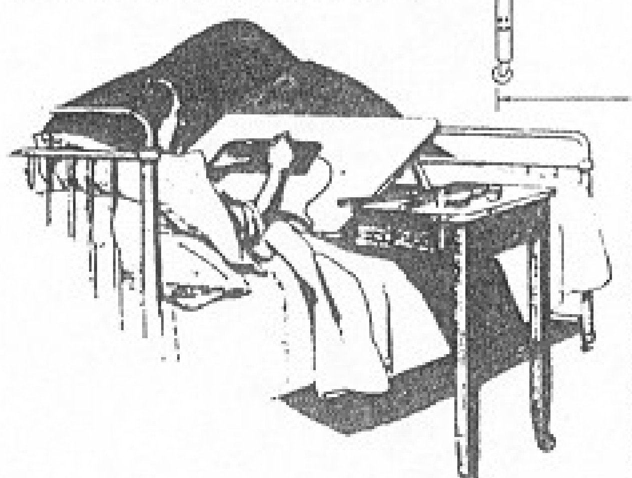
Connecting wires leading from the cabinet. The outfit operates on 110-volt house current

HOME WORKSHOP TABLE FOR INVALIDS

Popular Science Monthly — February 1936

WHEN recovering from illness or injuries, many men would be much more contented if they could do a little light craftwork. This is possible if a suitable worktable is provided. The one illustrated was designed for an invalid who cannot be bolstered to a position greater than about thirty degrees and was presented to him as a Christmas gift from a high school vocational carpentry class.





The dimensions or construction may be modified as desired to suit special cases. While the table is designed to be used astride a bed, it may also be used as an ordinary table or desk. Note how the hinged top and the front rail are cut out on a curve so the table will fit the bed closely.

REMOVAL OF GREASE SPOTS.

In removing grease spots from fabrics by means of benzine or petroleum it often happens that a colored and stained outline of the portion moistened is left. This can be prevented by the application of a layer of gypsum extending a little beyond the moistened region. When dry, the powder is to be shaken and brushed off, when no trace of the spot will remain.

KEEPING FISH FRESH WITH SUGAR.

A method adopted in Portugal for preserving fish consists in removing the viscera and sprinkling sugar over the interior, keeping the fish in a horizontal position, so that the sugar may penetrate as much as possible. It is said that fish prepared in this way can be kept completely fresh for a long time, the savor being as perfect as if recently caught. Salmon thus treated before salting and smoking possess a much more agreeable taste, a table-spoonful of sugar being sufficient for a five-pound fish.

SPONGY IRON AS A DEODORIZER.

By calcining a finely divided iron ore with charcoal the species of iron known as spongy iron is obtained, which, according to Dr. Voelcker, is a deodorizer of greater potency than animal charcoal. By filtering sewage water through this material it becomes thoroughly purified; a much smaller quantity than is required of animal charcoal answering the purpose. Water treated in this way, and kept from exposure to the atmosphere, has remained perfectly fresh and sweet for many months, without any indications of cryptogamic vegetation.

DETECTION OF ALCOHOL IN WATER.

According to M. Berthelot, the existence of alcohol in presence of a large quantity of water may be determined by means of chloride of benzoyl. This substance is decomposed very slowly by cold or lukewarm water; but if the water contain alcohol, benzoic ether is immediately formed: the ether is found with the excess of the chloride of benzoyl. Its presence can be made manifest by heating a drop of the chloride of benzoyl, which dissolves the acid chloride almost immediately without acting at first on the ether. Even with a thousandth part of alcohol the smell of benzoic ether is very apparent.

PUTTING UP PRESERVED FRUITS.

A convenient method of closing up prepared fruits consists in placing them in stone pots somewhat narrowed at the upper end, pieces of paper being laid over the fruit in such a manner that when the top is applied there will be no opening into the interior. Some gypsum is then to be mixed with water, and poured in a liquid form over the cover to a depth of half an inch. In a few moments the gypsum hardens, and the jar becomes air-tight; and the contents, it is said, will remain unchanged for years; the exclusion of the air being much more perfect than by the ordinary methods of closing with India rubber or with tin.

PREPARATION OF CARMINE-PURPLE.

The dye recently invented, and known as carmine-purple, is obtained by the solution of uric acid in nitric acid, care being taken to prevent boiling over and too great an increase of temperature. The mixture should remain standing quietly for some days, after which a thick, pasty, or doughy substance is obtained, which is to be treated with warm water, filtered, and the residuum again treated with warm water. The fil-

Nature's Factories REVEALED BY YOUR Microscope

BACTERIA, YEASTS, AND MOLDS PRESENT FASCINATING SUBJECTS FOR EXAMINATION

By MORTON C. WALLING

Popular Science Monthly — May 1936

Test-tube rack with cultures grown under a bell jar

WHEN the modern engineer or scientist speaks of a chemical factory, he usually is thinking of a huge brick or steel building containing an impressive array of distilling equipment, tanks, machinery, and other things. But nature, ages ago, perfected miniature chemical plants which make man's manufacturing efforts seem crude. Indeed, a number of modern industrial processes make use of these age-old chemical factories.

To see the midget chemical factories of nature, you need but turn to your microscope. Although there are a great many organisms in both the animal and plant kingdoms which make use of chemistry, we will consider here only a limited group, mainly some of the fungi, those plants related to and including toadstools and mushrooms. The group comprises also yeasts and molds, to which we will add bacteria.

It seems as if human chemists had imitated these midget factories to an excessive degree. Much of modern chemistry is devoted to the betterment of our lives, yet there are other chemical activities, such as the manufacture of poison gases for use in warfare, which are definitely destructive. In the same way we find, with the aid of the microscope, that the chemical plants of the invisible world can be divided into two groups: Some are engaged in honest, beneficial work, while others seem only to exist for the purpose of destruction.

Bacteria, for instance, are not all harmful. Growing in the roots of alfalfa and certain other plants are tiny organisms which take nitrogen that once was a free gas in the air and convert it into nitrogenous compounds which benefit the soil. In the manufacture of vinegar a tiny plant known as *Bacterium aceti* is necessary to convert the alcohol in hard cider into acetic acid. The acid may be distilled, if desired, from the vinegar.

These are examples of the good bacteria. Among those with more shady reputations are disease organisms, bacteria which cause the production of food poisons, and so on.

tered liquid possesses a reddish or yellowish color, resulting from the organic substances decomposed by the nitric acid. This liquid is now a mixture of alloxan, alloxantin, urea, paraban acid, dialuramid, and other products of uric acid. It is next to be evaporated in a large enameled iron vessel, but not heated to the boiling-point, which would destroy the murexide produced.

After the liquid has been evaporated to a sirupy consistency, and has assumed a beautiful brownish-red or violet color, it is to be allowed to cool. The entire quantity of the liquid should never be evaporated at one time, nor heated to the boiling-point.

SEA WATER IN BREAD-MAKING.

It was stated at a meeting of the Academy of Sciences of Paris that while excellent bread can be made with sea water, and that this forms a good tonic, soup or broth made with sea water is entirely uneatable. It would appear that the chloride of magnesium in the sea water is raised to a temperature, during the process of baking, sufficiently high to effect its destruction, and thereby cause its peculiar taste to disappear, which is not the case when merely boiled, as for soup. If, however, cane-sugar be added to the soup, a compound is said to be formed of the sugar with the chlorides which has not the disagreeable taste of the latter.

IODIZED COTTON IN SURGERY.

M. C. Méhu, in discussing the ordinary methods of applying iodine in cases of glandular swelling, goitre, etc., finds that the use of solutions is, in many cases, attended with inconvenience, and proposes to employ carded cotton, which, when impregnated with iodine in a special manner, is equally efficacious as a remedy, and unattended by any serious disadvantages. The iodized cotton is prepared in the following manner: A quantity of perfectly dry cotton, of good quality, is introduced into a stoppered flask of one-liter capacity, together with about one-tenth of its weight of finely powdered iodine, in such a manner as to distribute the iodine pretty evenly throughout the mass of cotton. The flask is then partially closed, and gradually heated in a sand-bath to expand the air. After a short time it is firmly stoppered, and the heat raised until the flask is filled with the vapor of iodine; this latter slowly combines with the cotton, causing it to assume a deep yellowish-brown color. As soon as the whole of the iodine is fixed on the textile fibre, and the violet vapor is no longer visible, the operation is terminated; the whole process, if well conducted, being effected in about two hours. Twenty grains of cotton-wool will be found sufficient for one liter; it is also unadvisable to exceed the proportion of ten per cent. of iodine, since, for general purposes, a cotton of half this strength is sufficiently active.

Although cotton can be made to absorb in this manner so large a proportion of iodine, it nevertheless preserves, in a great measure, its original tenacity. Its color is brown, and not black, which latter is sure to be the case if the heat employed be too high, or if its action be too greatly prolonged.

HAIR ERADICATOR.

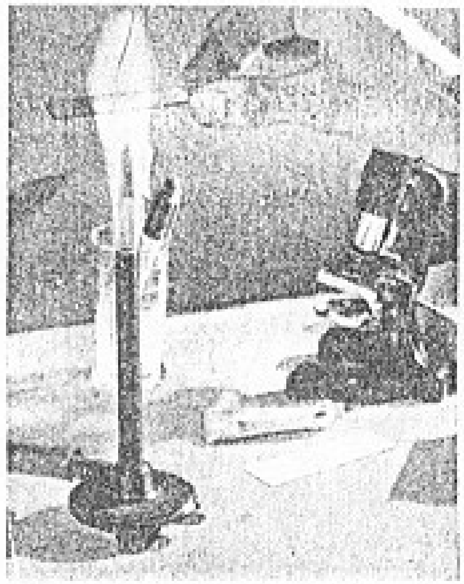
Professor Böttger recommends hydrated sulphuret of sodium as an extremely efficient and perfectly inodorous hair eradicator, and as being much more effective in this respect than hydrated sulphuret of calcium, previously recommended by him. The new extract is readily obtained by rubbing to a very fine powder one part, by weight, of crystallized sulpho-hydrate of sodium with three parts of fine prepared chalk. This

The poison-gas makers of so-called civilization have their counterparts in the bacterial world. Did you ever see a can of badly spoiled peas or beans with the ends of the can bulged out as if some one had pumped the can full of air at high pressure? The bulging came from compressed gas generated by bacteria acting on the food. Never eat food from a can that exhibits this bulging, or one which spurts its contents instead of drawing air inward when it is opened. It happens that some of the most deadly poisons known are produced by bacteria which may be present along with the gas-producing decay organisms.

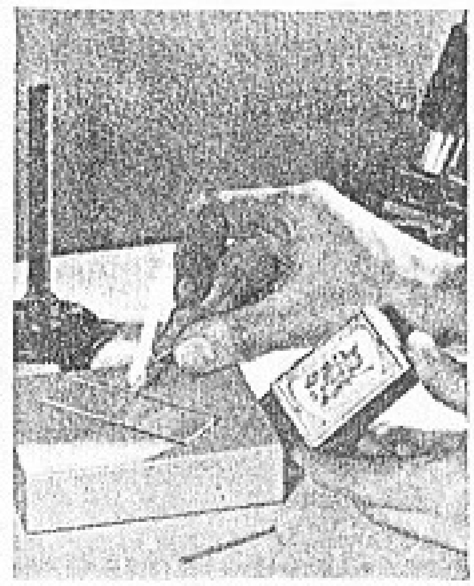
Chemical plants in the yeast field are, for the most part, either beneficial or only mildly undesirable. Perhaps the best-known members of the yeast family are those whose lives have been dedicated to the making of alcohol and alcoholic beverages. Known commonly as brewers' yeasts, these tiny plants, considerably larger in size than their relatives the bacteria, have been babied and nursed and cultivated for centuries, until today they are highly domesticated in comparison with the so-called wild yeasts.

Fermentation is a chemical process caused directly or indirectly by organisms, either animal or vegetable. Yeast is the most common organism used by man for this purpose. Its tiny cells have the power to secrete within themselves two enzymes —very active chemical substances. These enzymes have the power of converting sugar into alcohol and carbon dioxide gas. In this manner, yeast added to bread dough converts the sugar in the flour into alcohol and carbon dioxide. Bread becomes porous because of the expansion of these products.

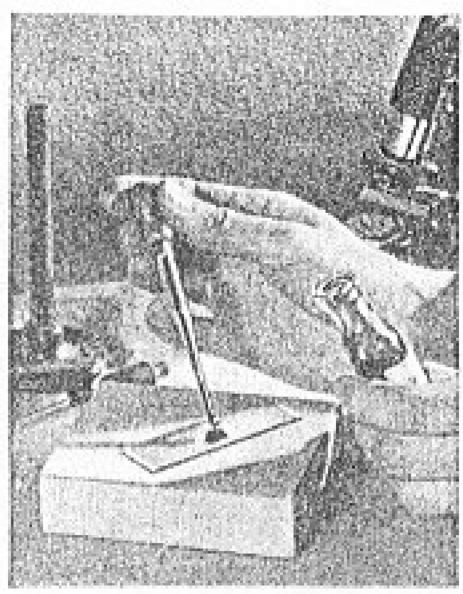
The third group of microscopic chemical plants are the molds. These for the most part have bad reputations because they cause food to spoil, attack various materials and weaken them, become bothersome when growing in photographic processing tanks, attack growing plants and fruits, and cause various diseases in man, such as certain respiratory infections. Some molds are beneficial because they help form humus, the important



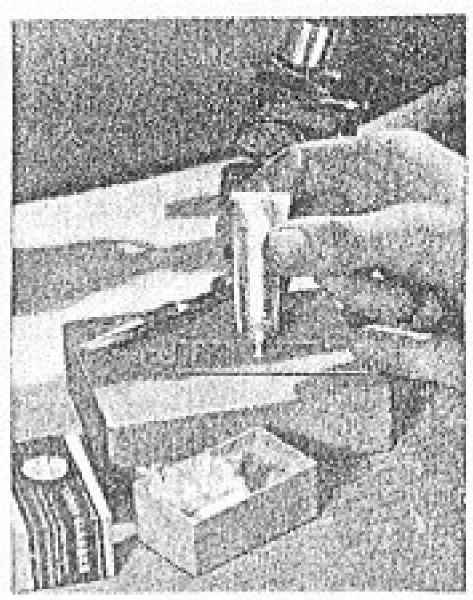
1 The first step in preparing a bacteria slide is to place a smear of the specimen on a clean glass slide and dry it by passing the slide through a gentle gas flame



2 To fix the bacteria, let a drop or two of alcohol fall on the slide and spread around the smear. Touch a lighted match to it, and the flame will fix all bacteria there



3 Place one of two drops of staining solution on the area that contains the specimens. After it has acted for a few minutes, wash it off with water and dry the slide



4 After treating with alcohol to remove excessive staining, apply a drop of Canada balsam to the slide and lay over it a clean cover glass, preferably a thin one

mixture is to be kept in well-closed bottles until needed for use, when a small portion of it is made into a thick paste with a few drops of water, and applied by means of the back of a knife to the spot coated with hair. In a very few moments the thickest hair will be converted into a soft mass, and can be easily removed from the skin by washing. Care must be taken not to keep the substance too long on the skin, as it would corrode it.

METALLIC SOAP.

Metallic soap in linseed-oil is highly recommended for coating canvas for wagon covers, tents, etc., as being not only impermeable to moisture, but remaining pliable for a long time without breaking. It can be made with little expense, as follows: Soft soap is to be dissolved in hot water, and a solution of copperas (sulphate of iron) added. The sulphuric acid combines with the potash of the soap, and the oxide of iron is precipitated with the fatty acid as insoluble iron-soap. This is washed and dried and mixed with linseed-oil. The addition of dissolved India rubber to the oil greatly improves the paint.

NEW FORM OF SENSITIVE FLAME

Most of our readers are familiar with the interesting physical fact that certain flames are exceedingly sensitive to sound, and have seen notices of the experiments of Professor Tyndall and Professor Pepper, in London, upon this subject. Quite recently, according to *Nature*, a new form of sensitive flame has been devised by Mr. Barry, of Cork, which is said to be the most easily affected one known, possessing the advantage that the ordinary pressure in a gas-main is quite sufficient to develop it. The method of producing it consists in igniting the ordinary coal gas, not at the burner, but some inches above it, by interposing between the burner and the flame a piece of wire gauze of about thirty-two meshes to the inch. A pin-hole burner is used, so as to produce a conical flame.

The gauze should be held steadily about two inches above the burner, by means of a retort-stand. The flame is a slender cone about four inches high, the upper portion giving a bright yellow light, the base being a non-luminous blue flame. At the least noise this flame roars, sinking down to the surface of the gauze, becoming at the same time almost invisible. It is very active in its responses, and being rather a noisy flame, its sympathy is apparent to the ear as well as to the eye.

To the vowel sounds it does not seem to answer so discriminately as the vowel flame of Professor Tyndall. It is extremely sensitive to *a*, very slightly to *e*, more so to *i*, entirely insensitive to *o*, but slightly sensitive to *u*. It dances in the most perfect manner to a small musical snuff-box, and is highly sensitive to most of the sonorous vibrations which affect the vowel flame, though it possesses some points of difference.

PREPARATION OF HIDES.

The following method is recommended for preparing leather. Begin by soaking the skin or hide eight or nine days in water, then put it in lime; take it out, remove the hair by rubbing, and soak again in clear water until the lime is entirely out. Put one pound of alum to three of salt, dissolve in a vessel sufficiently large to hold the hide; soak the hide in it three or four days; take it out, let it get half dry, and then beat or rub until it becomes pliable. Leather prepared by this process will not do well for

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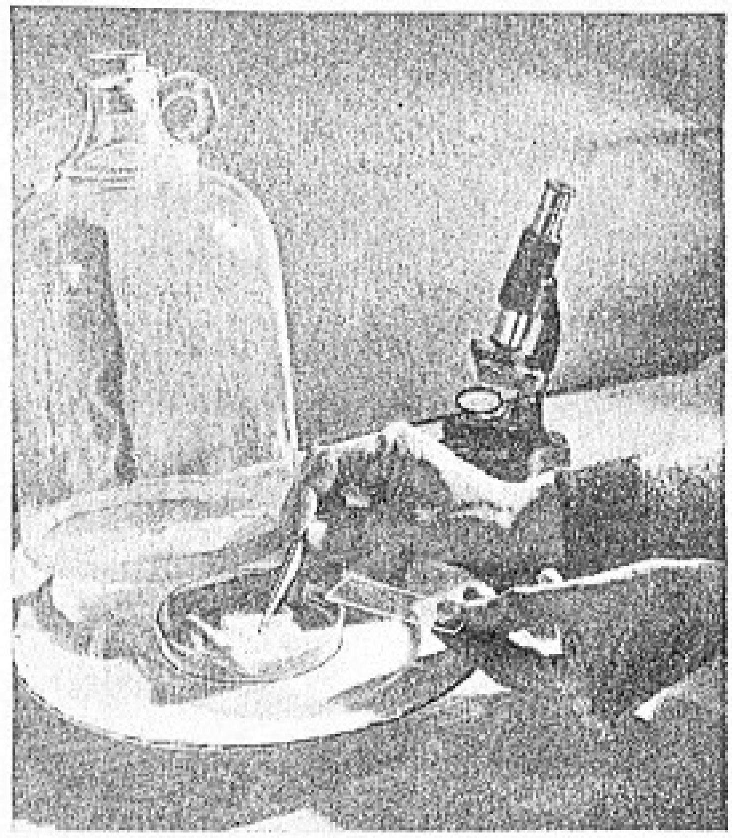


A sample of bread mold being collected from a piece of moist bread where it grew

organic soil material. Molds and bacteria extract nitrogen from dead plants and animal droppings and from them make ammonia and nitric acid which can be used as food by growing plants.

It is not difficult for the amateur microscopist to see and study these fascinating chemists. They are easy to find and not at all difficult to prepare for observation. The bacteria and yeasts require, for the most part, magnifications of 400 or more diameters, although some of the larger kinds can be seen at 100 diameters with good lenses. With the cheapest microscopes, it is not easy to see bacteria and yeast plants at any magnification.

While you can cultivate bacteria on beef-broth jelly and similar media, and obtain colonies of them large enough to see with the unaided eye, you can obtain all the specimens you want by simpler means. A drop of stagnant water; a smear of milk, preferably sour; a little buttermilk; a speck of decayed fruit; any of these will provide bacteria in abundance.

To prepare a slide of stained bacteria is a matter of minutes, after you have become familiar with the routine. You desire, for example, to see what manner of chemical plants are present in a drop of buttermilk. Scour a one by three-inch microscope slide, or better still, three or four of them, and wipe clean with a cloth. Heat the slides gradually over a flame, until too hot to touch, if you want to confine the bacteria supply only to those specimens present in the buttermilk. After the glass has cooled, spread a thin film of the buttermilk in the center of each slide. Set aside to dry, or hold the slides over a low flame until all moisture has evaporated.

It is now necessary to fix the bacteria present. This kills them and at the same time preserves their forms. Simply letting them soak for a few minutes in ninety-five-percent alcohol is one way. A quicker method is to let one or two drops of alcohol fall on the slide where the film has been formed, tilt the glass until the alcohol spreads in a thin layer, lay the slide on a noninflammable surface, and then touch a lighted match to it. The burning alcohol effectively fixes all bacteria present.

THE next step is staining. There are numerous bacteria-staining preparations available, some of them intended for selecting certain organisms to the exclusion of others, while some are designed to bring out certain characteristics of individual bacteria. For your purpose, Loeffler's methylene blue solution, which has been described in a previous article of this series, is excellent (P.S.M. April '36, p. 44). Methyl violet or mercurochrome can also be used. Lay the slide on the table, and let one or two drops of the stain fall on the area containing the fixed bacteria. After the methylene blue has acted for a minute or so, wash it off with clear water and dry the slide. Usually this overstains, so that the slide must be placed in alcohol, or a few drops of alcohol dropped on the stained area, in order to remove some of the methylene blue. The alcohol usually affects the stain in the bacteria less than in other substances on the slide.

Finally, after the alcohol has evaporated, place a drop of Canada balsam on the slide and over it lay a perfectly clean cover glass. Because you may want to inspect the slide through an oil-immersion objective some day, it is best to use a very thin cover glass such as a No. 1, so that the lens can be placed close enough to the stained bacteria to get them in focus.

In a similar way you can prepare slides of bacteria from various other sources, such as stagnant water, milk, and hay infusions. When treating milk or cream, it may be necessary to remove the fat globules present. This can be done by immersing the slide for a time, after the film has been fixed, in xylol.

Certain bacteria are highly dangerous—far more menacing, perhaps, than a roomful of dynamite. Unless you are an experienced bacteriologist, do not attempt under any condition to make slides of pus from wounds, sputum of diseased persons, material obtained from spoiled cans or jars of food, or organisms from any other source that might include bacteria of disease or infection.

YEAST plants are easy to prepare for observation. Get a cake of yeast from the grocer, soak it in a little water to make a thin

Test-Tube Rack Fits Under Bell Jar

TEST tubes make convenient containers in which to handle various cultures. If this method is followed, a test-tube rack becomes almost indispensable. A handy rack for this purpose, illustrated here, is easily made by the amateur microscopist.

The rack in use. The experimenter is dropping a piece of yeast cake into some dilute molasses

Obtain two two-foot lengths of one-quarter-inch hard-wood dowel stock, sufficient oak, maple, white pine, poplar, redwood, or cypress to make three disks measuring about one half inch thick and five and three quarters inches in diameter, a few brass nails or escutcheon pins, and a quantity of waterproof casein glue.

Cut the disks to the desired diameter and smooth the edges with sandpaper. Clamp all three of them to a faceplate. Remove the centers from two of the disks so as to leave a ring measuring one and one eighth to one and one quarter inches between outer and inner circumferences. Leave the third disk solid.

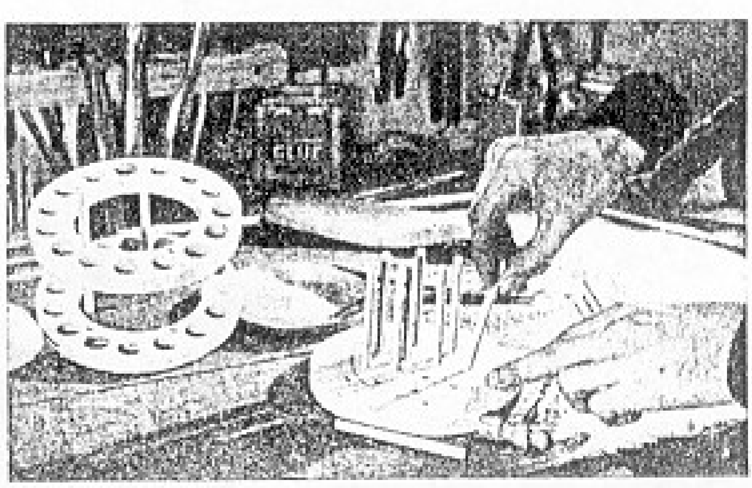
The rack shown here has an overall diameter of five and three quarters inches and fits inside a bell jar made from a one-gallon jug (see photograph on opposite page). In boring the test-tube holes, clamp the two disks together and bore through both at once. It is best to trace the design on paper and fasten this temporarily to the rings.

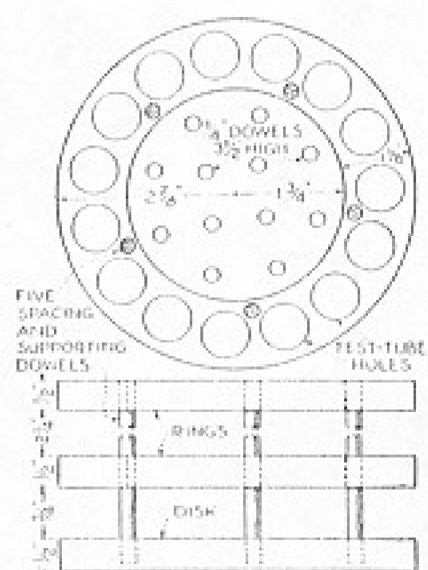
After the tube holes are finished, clamp the three circular pieces together and bore holes for the five dowels which act as spacers. The holes are spaced one between each group of three tube holes.

In the center opening of the rack can be glued a dozen pegs for holding tubes while they drain. These are spaced as shown. The pegs are 3½-inch lengths of one-quarter-inch dowel stock, which project three inches above the one-half-inch base piece.

The wood can be left unfinished, may be coated with waterproof paint or varnish, or treated with linseed oil. However, you probably will not find a finish that will resist alcohol, xylol, and other chemicals completely.

To make a bell jar from a one-gallon jug, fasten a glass cutter on a half-inch-block, with the cutting wheel held horizontally. Set the jug on the same surface that supports the cutter block and, by moving either the block or the jug, scribe a line completely around the side. Bend a piece of one-quarter-inch rod into a sort of hammer and tap the glass gently on the *inside*, opposite the scribe line. The bottom will separate cleanly if the scribing and tapping have been properly done. Bind the sharp edges with adhesive tape and insert a cork in the top.





Parts of the circular test-tube rack being assembled. The pins are quarter-inch maple dowels. The drawing at right shows the layout of holes, and how the parts go together

paste, and smear some of this paste on a slide. Add a drop of water, followed by a clean cover glass. Your microscope will reveal yeast as being a single-celled plant of extreme simplicity. Many of the cells, however, will be linked together, or will contain buds of various sizes. Such plants are reproducing. When a yeast plant grows, it sprouts a bud that becomes another yeast plant, and eventually breaks away to face life on its own. Sometimes, several new yeast plants cling together in a chain for a while before breaking up into individuals.

You can stain yeast plants by adding dyes to the water in which they are present. An easy way of doing this is to place a drop of stain at one edge of the cover glass and hold a blotter to the opposite edge. The stain will move across the slide, under the cover glass. In a similar way, you can flush the preparation with clear water after staining. Try methylene blue, methyl violet, eosin, and mercurochrome. You can cultivate yeast plants by placing bits of yeast cake or tablets in a solution of molasses and setting it in a warm place for a few days.

MOLDS, you will find, are more complex in structure than yeasts or bacteria, but are easier to study at low powers of magnification. One of the most common molds is *Rhizopus nigricans*, commonly known as bread mold. To obtain a plentiful supply, rub one side of a slice of bread across the floor, and then lay it, with the side that was in contact with the floor uppermost, in a saucer containing a little water. Set this in a dark place under a bell jar or other cover that will confine moisture. In a few days you ought to have a luxurious growth of mold.

Close examination of bread mold with the naked eye reveals that there is a layer of white, glistening material that looks like a blanket of fine wool or cobweb material. This is the mycelium. Rising from this layer of mycelium are tall stalks bearing tiny black balls. These balls are the sporangia, or spore-producing bodies. The spores, which do the same work as seeds in higher plants, are distributed over the earth by the winds. Bread mold also reproduces sexually, but more rarely than by the spore method. Between two hyphae or stalks there will develop short, bulbous branches whose ends come together and unite. There appears at this junction a thick-walled, dark-colored resting spore. Such spores have the power of producing a new mycelium whenever favorable growing conditions are found.

Under the microscope, bread mold becomes a beautiful and interesting object. Note that the hyphae or spore-bearing stalks are not divided into numerous cells as are the stems of higher plants like the clover. Try to find a spore chamber that has been broken open to release the myriads of tiny, black, football-like spores. Look also for resting spores (zygospores) between two conjugating filaments.

You can obtain other specimens from moldy foods of various kinds, such as spoiled oranges, decaying pears, or moldy cheese. Frequently profuse growths of molds, such as *Penicillium* and *Aspergillus*, can be produced by moistening pieces of bread with grape juice or cane-sugar water, and letting them remain for a few days under a bell jar as described. Do not inhale mold spores.

IN MAKING slides of bacteria, yeasts, and similar material which you want to distribute in a thin layer, you will find a little trick employed in research laboratories of

great help. This consists of cleaning two cover glasses, placing a drop of the specimen material, which always is in the form of a paste or liquid, on one glass, and bringing the other in contact with it. Let the cover glasses come together, but do not press them; then separate them at once by a sliding movement. This spreads the specimen material in a thin, even layer over each glass. After a little practice, you will be able to perform the operation easily. Tweezers for grasping the delicate cover glasses probably will help.

A common way of fixing bacteria when distributed over cover glasses in this manner is to pass the glass rapidly, several times, through the tip of an alcohol or gas flame. This takes the place of the flaming-alcohol method already described.

HOMEMADE ELECTRIC PEN

Burns Designs in Wood and Leather

Popular Science Monthly — April 1936

Fig. 1. Heated electrically by the ordinary house current, this easily made pyrographic pen can be used for a variety of decorative work

YOU will enjoy decorating wood, leather and other materials with this easily constructed electric pen, which has several novel features not found in other pens of this type. For example, in an instant you can change from a tip which burns narrow lines to one that is broad and large for burning in backgrounds. It is not necessary to wait for the point to heat up, as it becomes glowing hot immediately the current is turned on, and cools almost as quickly when you want to use another tip. This means that it is exceptionally speedy and works almost as fast as you can write.

The handle is made by wrapping a piece of sheet asbestos around a pencil so as to form a tube about 4½ in. long and of ½-in. diameter. Use water glass (sodium silicate) for a cement. Wrap a 1-in. strip of asbestos around one end to make a finger grip, half of it projecting beyond the handle tube so as to provide a space for the connectors into which the hot tips are to be inserted. Allow the handle to dry throughly before finishing it with enamel or lacquer. Constructed in this way, it is practical and safe, forming an insulation against both heat and electricity.

After passing the connecting cord through the handle, wind the bare ends around a No. 16 copper wire to form small coils, as shown in Fig. 2. These are the hot-tip connectors. Wrap them with asbestos and hold inside the finger grip with a putty made of asbestos and water glass.

The tips, which are very easy to make, consist of short pieces of nichrome wire (which can be taken from a heating coil), bent as desired and with the ends attached by crimping to short pieces of No. 16 wire. A V-shape tip will be found most useful for general work, while loops, squares, and other shapes are suitable for background work and for repeating a design a number of times.

When wood-burning designs call for a number of circles, a good kink is to make up a very short tip holder and attach it to a compass, as in Fig. 3, so that perfect circles of any size can be burned. A special tip for burning your initials on the wood handles of tools can be made by forming the nichrome wire around brads driven into a block of wood, as in Fig. 4. Any other small design or figure can, of course, be made in the same way.

Figure 6 shows the resistance unit into which the cord from the pen is plugged. It is merely a nichrome heater coil cut into one side of the current supply. Remove several inches of wire from the coil if you desire to have the pen tips glow white hot. The ordinary red heat is usually sufficient, however, unless hardwood is to be decorated.

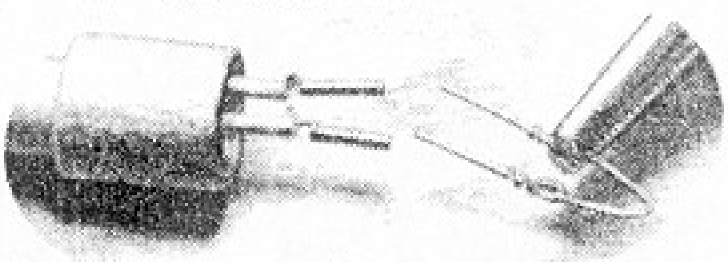


Fig. 2. The tips are made from nichrome wire to suit the work and inserted interchangeably into two coils of wire at the end of the holder, where they are retained by friction, as illustrated above

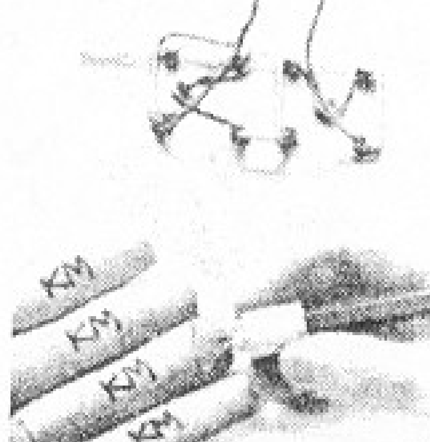


Fig. 4. By bending nichrome wire around nails (with heads cut off), a brand for tool handles can be made

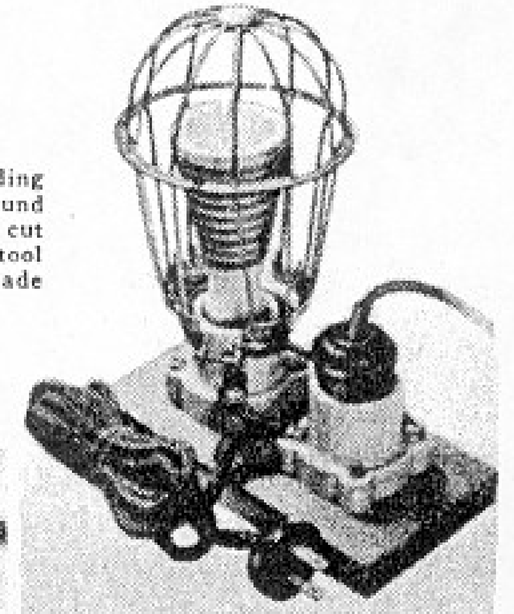


Fig. 6. The pen is used with a resistance unit, which is a nichrome heater coil in a guarded socket. A second socket is then added for convenience in plugging in the tool

Fig. 3. When it is necessary to draw circles with the electric pen, a special small tip is made as at the right and attached to one leg of an inexpensive compass

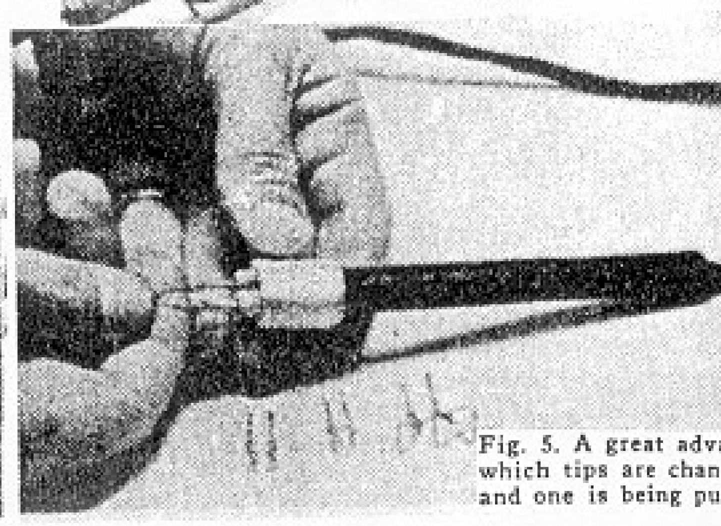


Fig. 5. A great advantage of this pen is the ease with which tips are changed. Several tips are shown below, and one is being pushed into the sockets of the holder

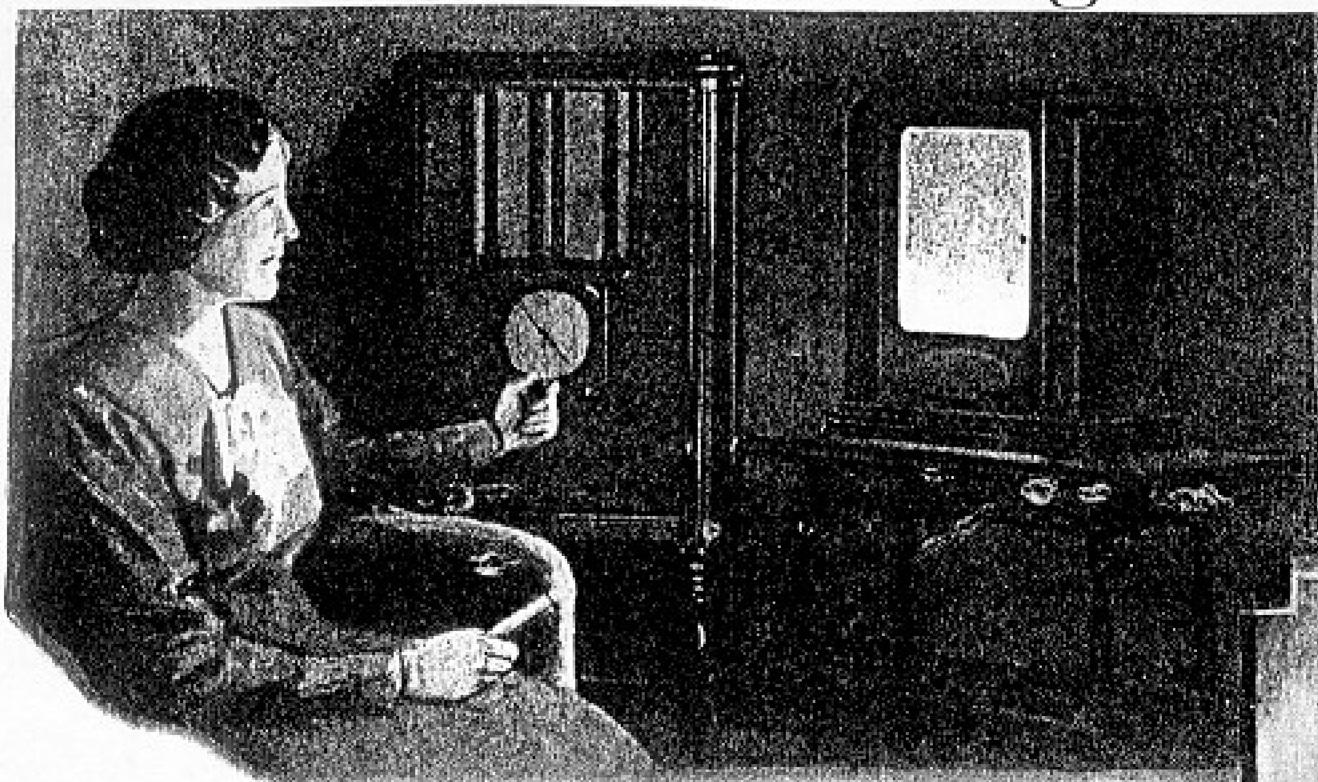
 THE SURVIVOR Vol. 5

Homemade Color Organ

PLAYS WEIRD RADIO ACCOMPANIMENT

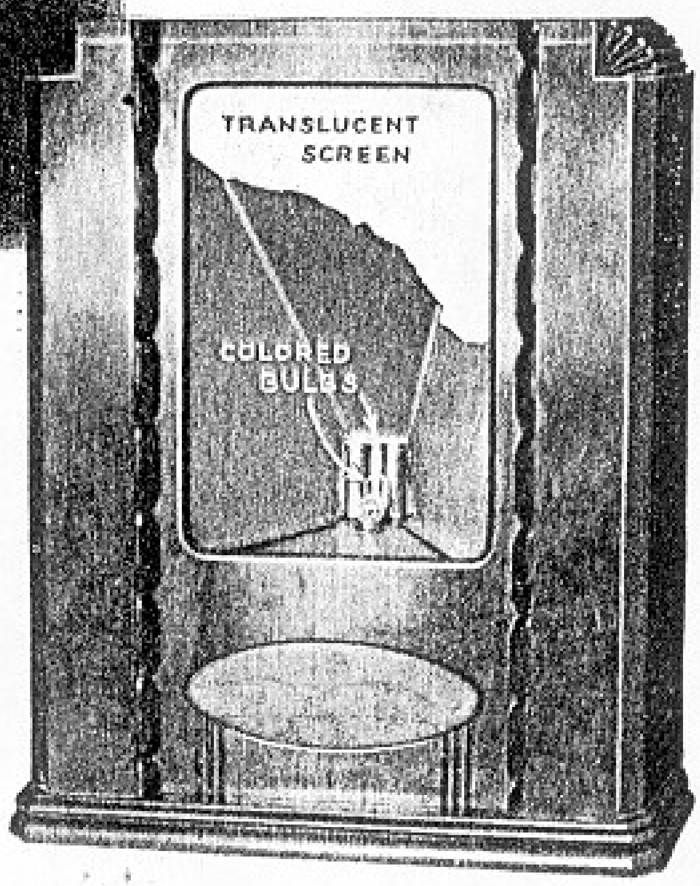
Music Is Interpreted In Vivid Hues on the Translucent Screen of This Fascinating and Easily Built Accessory

By
JOHN L. RENNICK



The automatic color organ in use. It is connected to the output of a broadcast receiver

POPULAR SCIENCE MONTHLY APRIL, 1936



HERE is the latest in radio novelties—a miniature color organ. Connected to a broadcast receiver, it translates sound into color to produce an accompaniment of colored lighting for any radio program. Its built-in screen glows in dancing hues as pleasing to the eye as music is to the ear.

Unlike most large color organs, which are manually controlled by a skilled operator, this circuit is entirely automatic; the predominant pitch of the music alone determines the color. Low notes bathe the screen with a deep red, the middle register shows in varying shades of green, while a brilliant blue responds to the high notes of the flute or violin. Blended combinations of these colors give the intermediate shades.

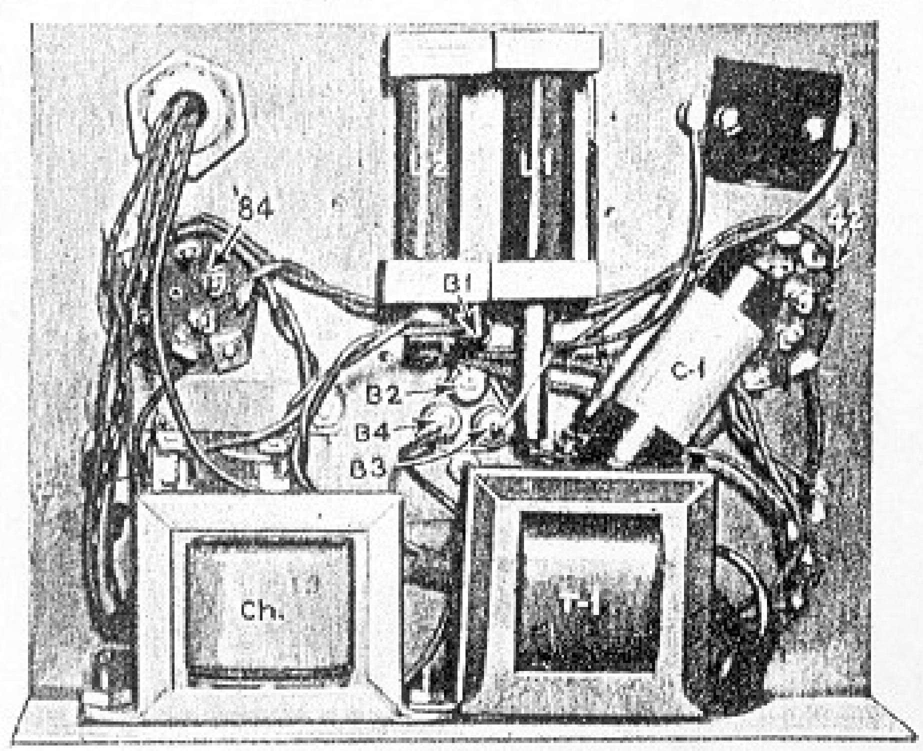
With present-day receiver tubes it is an easy matter to obtain sufficient audio-frequency power to light several miniature lamps. It only remains then to provide color screens for the lamps and to connect them in a simple frequency network designed to separate the "tones" and feed the power to the proper lamps at the proper time.

As arranged, the circuit is a compact combination of power supply, amplifier, frequency network, and optical system mounted on a steel chassis designed to fit a midget radio cabinet. It is completely self-contained. To put it in operation, it is only necessary to plug it into an alternating-current line and make the proper connections to the output of a standard receiver.

An examination of the circuit shows that the amplifier and power-supply connections are standard. The frequency network, shown at the right in the diagram, is the only unusual part of the entire circuit. It is fed through a standard speaker-coupling transformer (T_2) designed to work into an impedance of thirty ohms.

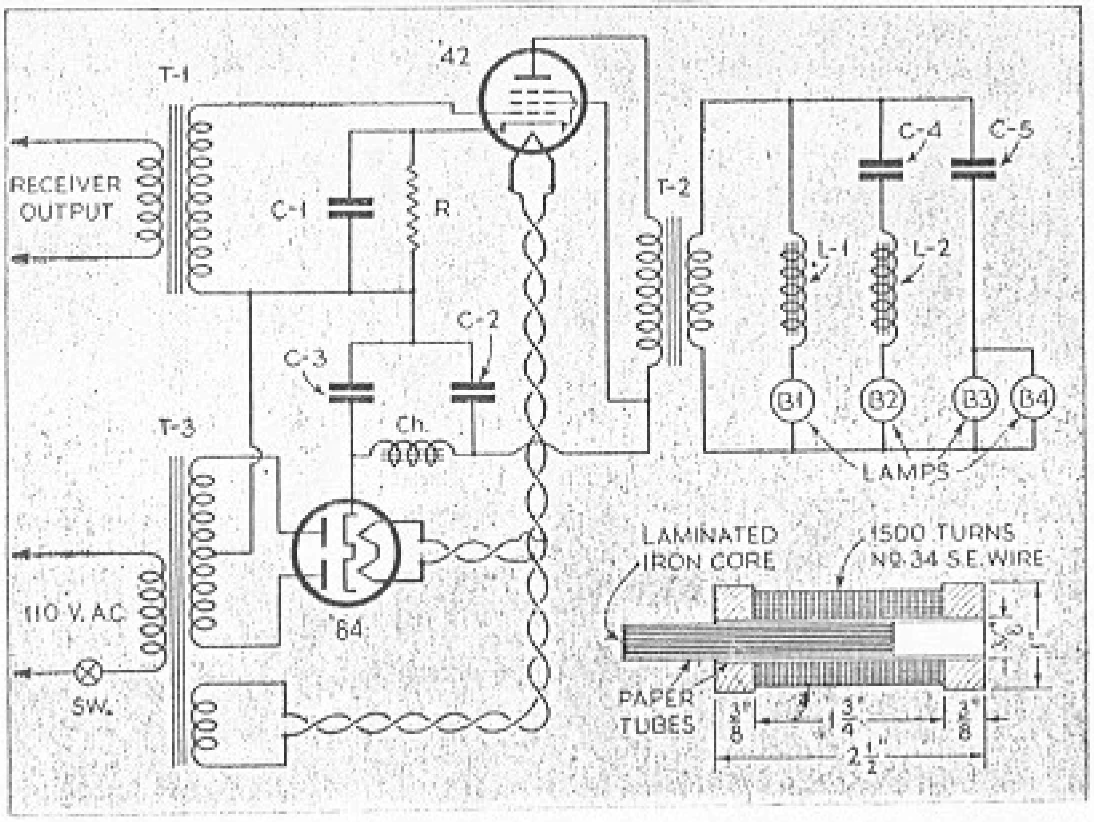
Frequencies below 300 cycles are passed by the first section of the network, which consists of an inductance (L_1) and a red lamp (B_1) connected in series. The inductance, shown in cross section in the drawing, is made by winding 1,500 turns of No. 34 silk-enamel magnet wire on a paper tube three-eighths of an inch in diameter and two and one-half inches long. A laminated core made up of straight iron wires is placed in another tube that is a snug fit inside the coil form. By sliding the core in and out, the inductance of the coil may be varied between wide limits.

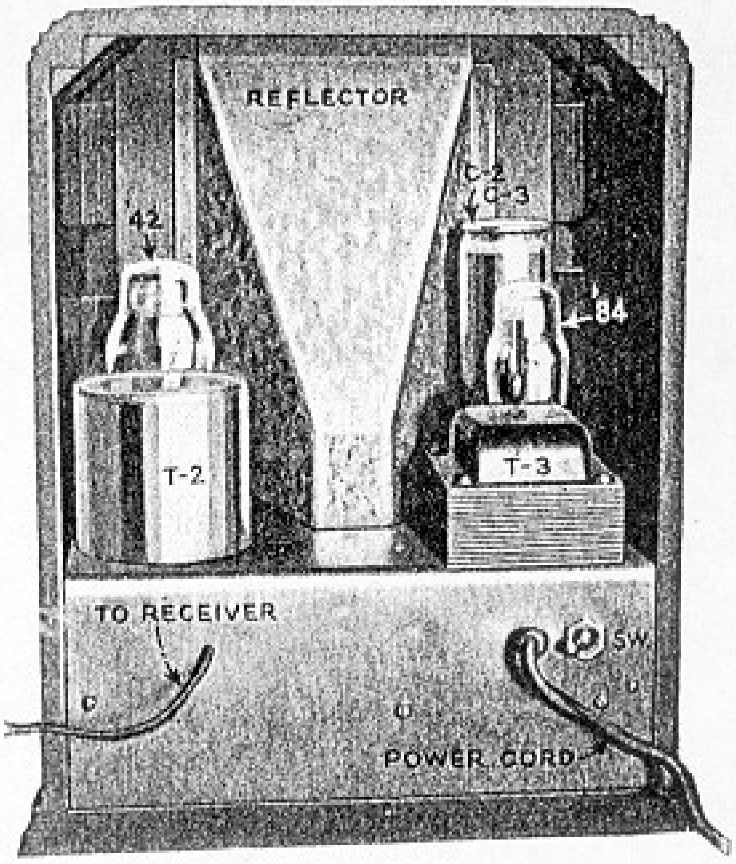
Although the second section is a series resonant circuit peaked at 500 cycles, it is so designed that frequencies as low as 250 cycles and as high as 750 cycles are passed. The circuit consists of a four-microfarad paper condenser (C_1), an inductance (L_2), and a green lamp (B_2), all connected in series. The condenser may have a low-voltage rating. L_2 is identical with L_1. B_2 in the



THIS CIRCUIT CHANGES SOUND TO COLOR

The upper view shows the front of the cabinet with the translucent screen removed to expose the reflector and the four colored bulbs. Above, bottom view of the chassis





This circuit diagram shows how easily the color organ can be wired. At the right is a rear view of the cabinet, which was salvaged from an old table-top receiver. Note the toggle switch

diagram is a six-volt dial lamp.

The third network section passes only those frequencies above 600 cycles. It is made up of a two-microfarad condenser (C_5), and two blue lamps (B_3 and B_4). These are six-volt dial lights connected in parallel. The use of two blue lamps is necessary to get a good balance of color.

Due to the overlapping of the frequency ranges, notes between 250 and 300 cycles will cause both the red and green lamps to glow, while frequencies between 600 and 750 cycles will light the green as well as the blue bulbs. This blending gives the intermediate tones and mixtures.

The optical system is extremely simple. It consists of a wedge-shaped, sheet-metal reflector and a rectangular translucent screen made of ground glass or tracing paper cut to fit the speaker opening of the cabinet. The lamp sockets are mounted on the chassis so that the bulbs themselves are at the rear of the reflector. The two blue lamps should be placed side by side at the extreme rear; the green and red lamps directly in front of the blue. The color screens are made of colored gelatin formed into small cylinders to fit over the lamps.

Although the placement of parts is not critical, the arrangement shown in the photographs is suggested as the most convenient layout. Looking at the rear view of the assembly, we see, at the right, the '84 rectifier tube mounted between the electrolytic filter condenser and the power transformer. At the left, the top of the '42 amplifier tube may be seen behind the can housing the network-coupling transformer (T_2). This transformer was sealed in wax to eliminate mechanical vibration of the laminations.

LIST OF PARTS

T_1.—Standard audio transformer, 3:1 ratio.

T_2.—Speaker coupling transformer, 7000-ohm primary, 300-ohm secondary.

T_3.—Power transformer, 650 volts CT at 50 mils, 6.3 volts at 2 amps.

C_1.—Tubular electrolytic condenser, 10 mfd., 50 volt.

C_2 and C_3.—Dual electrolytic filter condenser, 4 mfd.

C_4.—Paper condenser, 4 mfd.

C_5.—Paper condenser, 2 mfd.

Ch.—Filter choke, 30 henry.

L_1 and L_2.—Network inductances (see text).

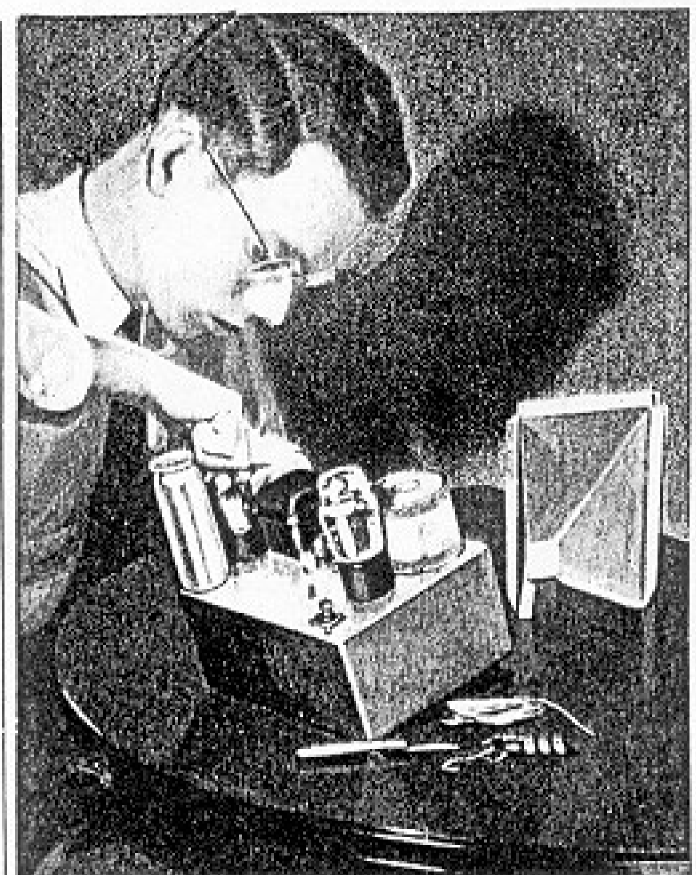
R.—Resistor, 500 ohm, 2 watt.

B_1.—Flash-light bulb, 3.2 volt.

B_2, B_3, and B_4.—Dial lamps, 6 volt.

The under view of the chassis shows clearly the construction and placement of the network inductances. The sockets, placed immediately below these coils, may be of the standard type used on illuminated dials, or may be taken from a string of Christmas-tree lights. The power-supply choke and input transformer also show prominently in this view of the chassis.

In operation, the primary of the input transformer (T_1) is connected across the primary of the speaker-coupling transformer of the receiver (in parallel with the speaker circuit). Usually, the connections can be made directly at the speaker terminal block. If this is not practical,



Receiver parts composing the circuit are easily assembled. The reflector is seen in the background

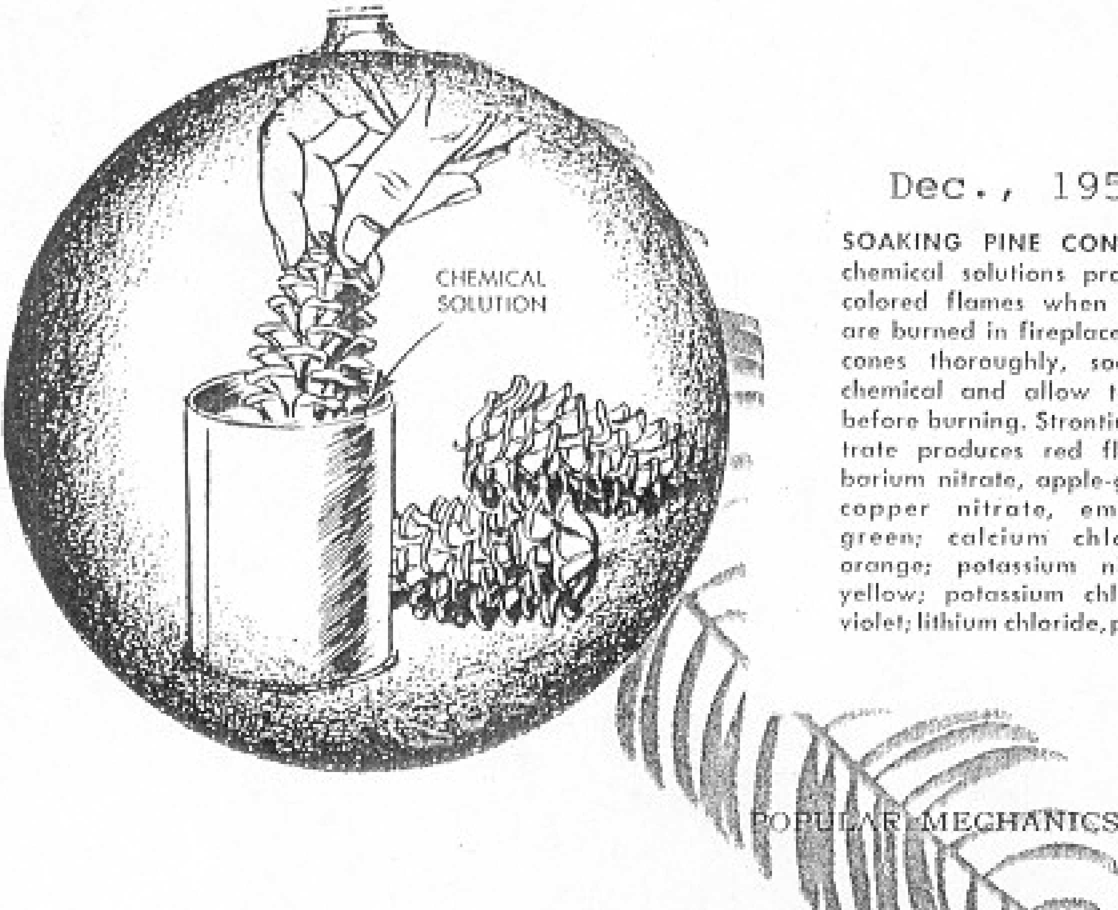
however, they may be made to the prongs of the receiver output tubes by wrapping the leads around the plate prongs if the circuit is of the push-pull variety, or to the plate and screen prongs if the receiver uses a single pentode in the final stage.

To adjust the network, decrease the receiver volume until the lamps glow at a little less than normal brilliancy. Then set the movable cores of the inductances so that the load appears to divide among the lamps according to the frequency of the signal. Bass notes should cause the

red lamp to light up brightly, but should have little effect on the others. The average speaking range should cause the green light to glow strongly, while only high notes affect the blue lamps. No adjustment is provided for the latter; they will take care of themselves if the other two are adjusted properly.

Unless a variable audio-frequency generator is available, the inductances must be adjusted by experiment, the appearance of the viewing screen serving as a guide. If the network connections are made correctly and the constants given are followed, the average set builder should have little difficulty. It is important, however, that the network specifications be followed to the letter.

In experimenting with the completed organ, you will find that the best color combinations are obtained from music of the classical or semi-classical type.



Dec., 1952

SOAKING PINE CONES in chemical solutions produces colored flames when cones are burned in fireplace. Dry cones thoroughly, soak in chemical and allow to dry before burning. Strontium nitrate produces red flames; barium nitrate, apple-green; copper nitrate, emerald green; calcium chloride, orange; potassium nitrate, yellow; potassium chlorate, violet; lithium chloride, purple

POPULAR MECHANICS

Popular Mechanics

MAKE LEATHER OF FISH SKINS.

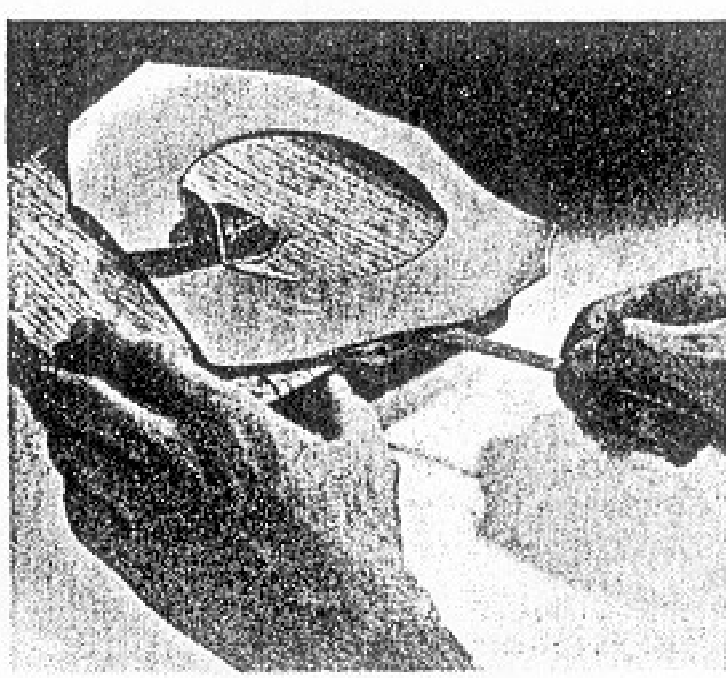
July, 1902

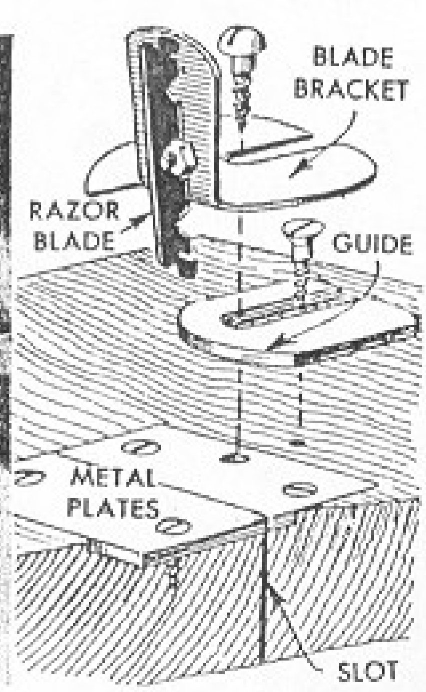
Skins of fish and various kinds of animals that not long ago were considered useless are now found to make excellent leather. A northern firm recently manufactured shoes of the skins of codfish and cusk. Whip handles are made of sharks' skins. Porpoise leather make the finest razor straps, and whale skins make admirable leather for many purposes. Seal leather is made into pocket books and many other useful articles. Salmon hide makes waterproof shirts and hats for the Eskimos. Overalls of tanned fish skins are worn by the natives on the lower Yukon in Alaska. Walrus leather and sea elephant leather are seen on the market, but as both these animals are nearly exterminated it will amount to but little commercially.

Scrap Leather Pulled Through Cutter to Produce Lacing

POPULAR MECHANICS Feb., 1951

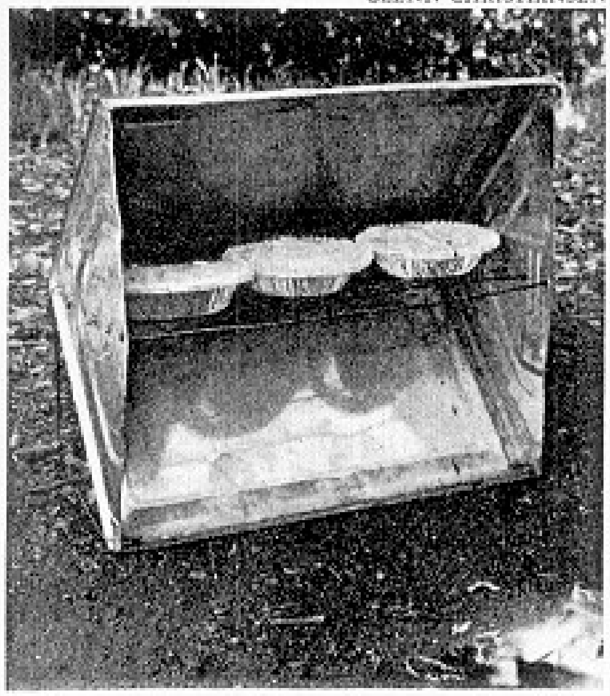
Lacing of almost any desired length and reasonable width can be made quickly by rotating a piece of scrap leather on this easy-to-make cutter. A razor blade held at a slight rake by a sheet-metal bracket provides the cutter, and a slotted wooden base receives the lower end of the blade. Note that the metal guide, which controls the width of the lacing, is inserted between the mounting bracket and metal base plates. The latter are set flush with the surface of the wood. The guide is adjusted by loosening the blade-bracket screw and the guide screw, and the blade is moved to renew the cutting edge simply by loosening the machine screw which holds it to the bracket.





To cut the lacing, first cut a small disk from the center of the leather scrap and place the scrap over the blade bracket. Then insert the edge of the leather under the lip of the blade bracket, bring it in contact with the blade and slowly rotate the leather counterclockwise. When the lacing projects from under the leather, grasp the end and pull until the desired length is attained. —C. Mendendorp, Grand Rapids, Mich.

GLENN CHRISTIANSEN



Reflector oven *test on frozen pies. They baked in 20 minutes—4 minutes less than package recommended for regular oven*

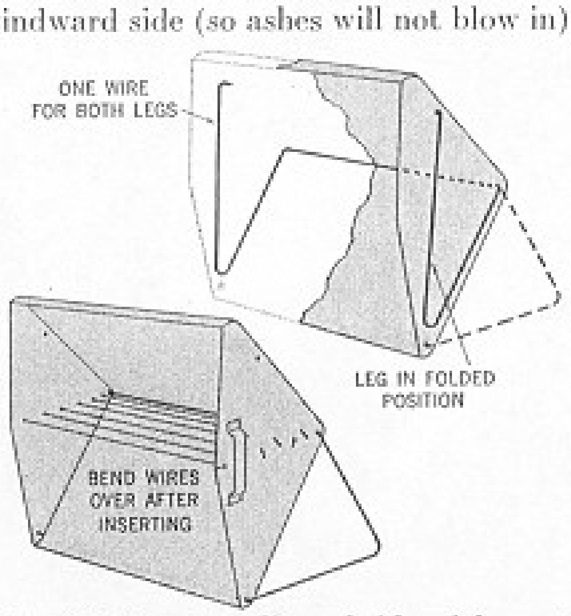
SUNSET OCTOBER 1962

Easy-to-make reflector oven

The cost of the reflector oven pictured above was 10 cents.

To make one like it, obtain a clean, 5-gallon rectangular can from a paint store (one that held paint thinner or liquid wax) and cut it approximately as shown. Such cans are usually available for a very small charge. Use coat hangers or similar heavy wire for the grill and the folding legs, and make holes for these wires with a punch or an ice pick.

Like the reflector ovens you can buy, this simple version gathers heat from a campfire with surprising efficiency. It will bake, roast, and broil, and you do not have to wait for glowing coals. It will heat while the kindling burns. Place it on the ground about 2 feet away from the fire on the windward side (so ashes will not blow in).



Cut *with tin snips, discard side with spout. Bend ¼ inch of each edge over with pliers*

MIGRATION

By Kurt Saxon

A few survivalists have considered migration as a way of getting out from under the impending doom of the American system. R. Hodkinson of Australia recommends his country as a place for Americans to settle. He means well but he obviously has known few Americans.

For most American migrants to Australia, the place is a miserable experience, both for them and the Australians they deal with. I will go into detail about this, but first, let me point out the general impracticality of migration.

Most Americans believe the world is their oyster. They feel their influence, their products, their trade, makes them welcome anywhere. This is true only when they go to other countries as tourists. They take money which they intend to leave behind when they go home.

All tourists are welcome, anywhere, by those who make their living off tourists. Tourists are usually insulated from anti-American sentiments, as the authorities and those living off the tourist trade are verbally and even physically rough on their nationals who accost tourists with belligerence.

So Americans who have traveled to other countries, spent all their money and left, come home with much praise for the polite and quaint natives they met. In most cases, the natives were polite only because they expected payment and also because they knew the arrogant, cloddish Yanks would soon go home.

But when an American migrates to another country, the mask of politeness is off. He is a competitor and, as a national from a country with a higher standard of living, is considered a loser and a fool.

Since he has little money, except what he might earn there, he is no better than the natives. He is also astonished by the realization that he is now in the same position as the Puerto Ricans in New York or the Carribean blacks and East Indians in England. For the first time in his life, he is a dependent foreigner and is treated as such.

I migrated to Australia in late 1962 for various reasons; the main one being a quest for adventure in what I considered to be a new frontier. Also, I believed America was going socialist and didn't know Australia was much further along the same road than we were.

You must realize that Australia has obviously changed in the last 17 years, but, as a migrant, I'm sure I would run into the same general problems I confronted then. Although the standard of living might be somewhat higher, the people and their attitudes toward foreigners cannot have changed much.

Furthermore, although the following my seem very critical of Australians, I would probably have had just as hard a time anywhere else I migrated to. For it is their country and their ways. And their attitudes against Americans were mainly formed by Americans who had been looting Australia for years. Also, I've never gotten along with Americans so why should I get along with Australians?

Even so, most of the Americans I met there were just as hostile to the Australians as I was and they were also just as obnoxious as I was and I didn't like them any more than did the Australians. Few of the other Americans were migrants. Most of them were businessmen taking unfair advantage of the Australians. It wasn't that the Australians were stupid. It was just that they were less sophisticated than the sharper Americans. The term "Robber Barons", as applied to our 19th and early 20th century millionaires would be mild in comparison to the crooks I saw bilking the Australians.

As a near penniless migrant, though, I didn't feel that I should be treated with the same scorn as the Americans who deserved it. But I got it anyway, even though I had gone there with the idea of being an asset to the country.

The reason that I had so little money was that I didn't take advantage of the

Continued from page 1874

shoes, but answers for hamstrings, back-bands, and other purposes on the farm.

METACHLORAL.

Dr. Richardson, of London, has lately been experimenting upon metachloral, a substance possessing mild narcotic properties, isomeric with chloral, and produced when chloral hydrate is brought into contact with sulphuric acid. Chloral is also changed spontaneously into metachloral when kept for a long time in a stoppered bottle, or when a quantity of water insufficient to produce the hydrate is added to it. Heat converts metachloral into the liquid chloral, which becomes the hydrate on the addition of a sufficient quantity of water. Dr. Richardson also calls attention to the fact that chloral, from its affinity to water, is a caustic, and that its use may, perhaps, sometimes be advisable in this connection, in view of its after soothing effects.

ACTION OF BROMIDE OF POTASSIUM.

Since the first introduction of bromide of potassium into the *materia medica* there has been a great diversity of opinion in regard to its value as a remedy, some praising it extravagantly, and others denying it any specific virtue. Most writers, however, are satisfied that, judiciously administered, it is a substance of very great merit, although its mode of operation is even yet not entirely understood. According to Dr. Amory, its effects are produced by the direct action on the blood-vessels, or the vaso-motor system which controls the action of these vessels; and he thinks that this action will account for and explain all the physiological and therapeutical influences of the drug. He states that the bromide is easily absorbed by the mucous membrane and by the skin, provided the water in which it is dissolved is below the temperature of 75°; that its elimination is conducted by the skin and the kidneys, and that in therapeutical doses it is not eliminated by the intestines or the lungs; that it passes out of the skin without decomposition; that the larger the dose the more intense and enduring the influence in the vaso-motor system; and that its action in the general nervous system is consequently dependent upon that of the vaso-motor nerves, upon which it acts as a sedative. The highest value of the remedy as a medicine is said to lie in its remedial powers over epilepsy, being of signal service in the vast majority of cases, while absolutely curing very many, and rarely failing to diminish the number and violence of the attacks where it does not cure. One advantage of the bromide of potassium is said to be that it can be given without any danger whatever. Certain inconveniences sometimes present themselves, such as the production of acne, or other eruptions on the face or elsewhere, although, on the other hand, such diseases have sometimes been cured by it. In full doses it is said sometimes to cause redness of the palate, epigastric heat, salivation, drowsiness, confusion of mind, depression, failure of memory in a remarkable degree, weakness of the arms and legs; but all these evils disappear entirely on the discontinuance of the remedy, no permanent ill effects having been observed to follow its employment.

LOSS OF POWER.

Force is measured among English-speaking people, as is perhaps generally well known, by *foot-pounds*—that is, the unit of force is that quantity required to raise 1 pound 1 foot high, against the action of gravitation, at the surface of the earth.

Australian government's "assisted passage". Assisted passage was a government con whereby they payed about three quarters of a migrant's passage. The ripoff was that one couldn't leave the country until the assisted passage, amounting to several hundred dollars, was paid back. Since few migrants could get decent jobs, and if they did, the pay was barely enough to live on, one could not hope to save the money, so was trapped. I paid my full passage so left when I'd had enough.

Wages then were one third for the same job an American got over here. The average wage in New South Wales was 18 pounds a week at $2.25 per pound. Food and rent were cheaper than here but manufactured products averaged three times higher, due to high tariffs on imports to compare with the naturally higher prices of Australia's smaller industrial output.

Resentmant of Americans was deep-seated and mainly originated from the Second World War when hundreds of thousands of Americans were stationed in Australia as a base for attacking the Japanese. The Australian serviceman was paid very little and the American G.I. was comparitively rich. They literally bought up all the women, which enraged the Australian men. Like the British, the Australians complained of the G.I.'s that they were "over paid, over sexed and over here".

The Australians seemed to think they could beat the Japanese all by themselves, or at least the ones that attacked Australia. They may have been right, as the Australian soldiers are among the best in the world; as good or better than American Marines.

Anyhow, much of the anti-American sentiment is male-oriented. Australian women are very nice and very pretty, on the average. They never gave me any problems, I think because since their desirability was a big part of the conflict, they were too flattered to get into the Yank-baiting game.

As a reporter, I decided to get work in that line. I had rented a TV and read all their newspapers before making any applications. Although most of their news about America was from U.S. news films beamed over there, their papers were biased to the point of outright lies. They have freedom of the press, as do we. But freedom of the press is all too often a license to defraud the intellects of the reading public.

I watched the account of the blacks kneeling on the steps of a Southern courthouse at a civil rights demonstration. This was against the law so the cops, with dogs, moved them off and there was a riot. One black was flicking his jacket at a dog, got too close and was bitten.

The news film plainly showed that the dog was leashed and the black just had no judgement of distance. Next morning, the Sydney Morning Herald showed a picture of the black being bitten but they had blocked out the leash, giving the impression that the dog had been set loose against demonstrators.

There were, and are, enough things wrong with America that one doesn't need to lie to point out U.S. defects. I decided to get even by going to work for the Sydney Morning Herald.

When I applied for work as a reporter I was turned down with the explanation that they didn't need any help. Maybe they didn't, but I found later that they wouldn't have hired me anyway. Later, in Cairns, Queensland, I applied at their paper and the editor told me bluntly that he needed a reporter but he wouldn't hire a Yank.

The Sydney editor was nice enough to refer me to the women's weekly supplement of the Herald. I went upstairs and talked to the editor there. He didn't want to hire me either, although he did need someone. I persisted and asked him to at least let me show what I could do so he could see that I could write.

He dug into a drawer and got a pile of rejects which were the worst garbage I'd ever read. I then went to a spare typewriter and rewrote several of the articles. I reworked them into some highly readable stuff and he was so impressed he hired me as a sub-editor.

This consisted of proof-reading, rewriting hideous romantic drivel sent in by semi-literate women, and writing captions to pictures. Actually, the whole

Heat is measured, among English-speaking people, by what is called the *Fahrenheit unit of heat*, which is that quantity required to raise the temperature of 1 pound of water 1 degree of Fahrenheit's thermometer.

The French measure heat and force in a similar manner, deriving their units, however, from the French standards of distance and weight.

The following facts are derived from statements made by the President of the British Association at the last meeting:

One unit of heat is equivalent to about 186 foot-pounds of force—that is, the heat necessary to raise the temperature of 1 pound of water 1 degree is sufficient, if employed as a mechanical force, and provided it could be *all* so employed, to raise about 186 pounds 1 foot from the ground.

The heat produced by the combustion of 1 pound of coal amounts to *twelve thousand* units—in other words, it is sufficient to heat 12,000 pounds of water 1 degree, or 1 pound of water 12,000 degrees, or the equivalent of that degree of heat in any form; and these 12,000 units of heat, if converted into force by being employed in expanding some substance capable of expansion, as steam, would be sufficient, at the rate above mentioned, of about 186 foot-pounds of force for every unit of heat, to produce over two millions of foot-pounds of force—the figures were 2,240,000. In other words, the combustion of 1 pound of coal yields force enough to lift 2,240,000 pounds of water 1 foot high, or over 1000 tons 1 foot high, or 1 ton 1000 feet high. It seems astonishing that so much force can be involved in so small an amount of combustion; but the proof of the fact is conclusive. Now of this force employed in the use of the best constructed engines *more than one-half* is lost. The best pumping-engines for the English mines raise only 1,000,000 pounds of water 1 foot for every pound of coal consumed, instead of 2,240,000 pounds.

The loss is still greater in other modes of utilizing heat in the mechanic arts. For example, in the use of coal for heating purposes in furnaces, 1 pound of coal should be sufficient to heat 33 pounds of iron up to the welding point; whereas in practice, in ordinary furnaces, not more than 2 pounds are so heated. The most of the heat is lost through the walls of the furnace, expended in driving the blast, or consumed or wasted in other ways. Thus, in pumping water, less than one-half the actual power developed by the combustion is realized in the actual result, and in heating processes only about one-sixteenth of it.

These facts are in one sense very encouraging, as they show what a field is open before future inventors and discoverers for improvement in the methods of utilizing the vast reservoirs of power contained in the earth's stores of coal.

THE CONSTITUENTS OF WATER AS A SOURCE OF LIGHT OR HEAT.

From time to time a paragraph appears in the newspapers either suggesting the feasibility of obtaining light and heat from water, by decomposing it in some manner, and then recomposing the elements, or else announcing the successful accomplishment of the object by some ingenious discoverer. The elements of water are, as is well known, oxygen and hydrogen. The chemical combining of these substances is attended by the development of great heat, which of course may be converted into power, and also (under certain combinations) into intense light. Sanguine inventors and discoverers are accordingly often arising, who say, "Why delve with such infinite labor into the earth for hundreds or thousands of

staff practically wrote all the stories sent in, they were that bad.

Although socialists, the half dozen staff were intelligent and witty and I liked them. I got along all right for a couple of months until the editor asked me to write lying articles about Americans.

First, he asked me to write an article on how American women celebrated May Day. I told him American Women didn't even know what May Day was. He said he knew it and I knew it but the Australian women didn't. I refused.

Later, he wanted me to write about the subjugation of the American negro. Instead, I wrote an article entitled, "Don't Pity the American Negro". In it, I pointed out that American blacks owned more cars, homes, businesses, etc. than all the Australians put together. Also, that blacks on welfare got more than the average Australian worker.

I then pointed out that the Australian blacks, the Aborigines, could not cross state lines without police permission, got half the pay of whites doing the same jobs and had no political representation. I don't think they could even vote. Also, at that time, they couldn't buy liquor. My boss then transferred me to another department, gave me hardly anything to do, and when the quarterly layoff period came around, I was out.

As much as Australians despised Americans, I believe they hated the English more. While I was still a sub-editor, Queen Elizabeth and Phillip visited Australia. They came over in a small ship and Liz was very seasick and, as I remember, she had the trots.

The staff women went to the dock to interview them. When they came back they joked about the Queen's condition. One said, "Poor bitch; I hope she dies". Another went on about the foul language used by Phillip to the press and said he was a homosexual. I didn't believe the last part but could imagine his reasons for swearing at Australian journalists.

The next evening I watched Liz on TV. Although I care nothing for the monarchy, I was angered by the Australians' treatment of her. For three hours they kept the cameras on her while every Australian politician got up and gave a stupid speech. They were no better nor worse than American politicians. Totally degenerate. They each droned on for from five to ten minutes.

But even worse than forcing her to listen to all those clods, that camera was on her the whole time. She couldn't scratch, yawn, stretch or do anything one would normally do sitting in a chair for three hours. So for three hours, she posed like a graceful statue, showing as much poise and class as the Australian government owned TV station showed their incredible rudeness and inconsideration. That woman is a real lady.

As if to outdo the press and TV, that section of the government bureaucracy in charge of protocol, not only made fools of themselves, but did their best to kill her. First, they had her tour a hospital. Around the hospital were some piles of coal. They sprayed the coal piles white.

Then there was this patient named Townsend. The English Captain Peter Townsend was a commoner who had had an ill-fated affair with Princess Margaret. Believing Liz might happen upon this Townsend, ask his name and become embarrassed, they sent the poor devil home prematurely. Even if she had talked to him, the similarity of names wouldn't have phased her.

Following this idiocy they sent her up to Darwin, a tropical hell in Northern Australia, to watch a rodeo. It was over a hundred degrees in the shade and the humidity was unbelievable. She was out in the open with only a canopy for shade. Seven bulls died of heat prostration before her eyes. I don't think she's been back to Australia since.

After being laid off I took several temporary jobs and with some money from home, I bummed around New South Wales and Queensland for a few months. Then I went back to Sydney and applied for workaway passage on any ship leaving for home. Workaway means only food, a cabin and passage, but no pay.

While waiting for a ship I hung around observing and talking to Australians. I liked them, generally, but they had a bad habit which I don't think is shared by Americans. Upon meeting an American, the average Australian would rattle off

feet through solid rocks after coal, when we have the elements of the most powerful combustion known, in exhaustless quantities, always at hand in the water of our brooks, cisterns, and wells?"

This seems to many persons who are but little acquainted with the scientific principles involved to be very plausible; so much so, in fact, that individuals of that class often sincerely believe that the problem may be solved, and sometimes make serious efforts, and spend much time and money in their attempts to solve it. Others, and these cases are probably the most numerous, make use of the plausibility of the idea as a means of procuring money from men who are in possession of more money than science, and who say to themselves, "It is not much that he wants. It will be of no great consequence to me if I lose it; and the invention *may* come to something after all."

The real state of the case is, that the heat and light developed by the combustion of hydrogen—that is, by the chemical union of that substance with oxygen—is the measure and expression of the force with which *they come together*; and all that force—the whole of it—has to be overcome, in some way or other, in getting them separated. The hopeless impossibility, therefore, of accomplishing any useful end by this means is shown by the fact that there must be expended at least as much force in getting the oxygen and hydrogen of the water apart as they will give out by the energy with which they come together again; and so nothing will be gained. You must procure and expend the coal, or some other substance containing a latent store of force, to overcome the intense energy with which oxygen and hydrogen are, under favorable circumstances, drawn together, and by which, when once united, they are *held in combination*. This intense energy was the origin of all the light and heat—that is, the *force* developed by their union, and must now be overpowered by superior force before they can be separated.

The case is exactly analogous to that of a farmer who thinks he has a great water-power on his land because he has a large pond in a valley, and a long, descending ravine coming down a mountain by the side of it. "All that is required for a water-power," he says, "is a supply of water, and a descent down which it may flow." The scientific reply would be: "True, water and a descent are elements which can furnish power; but they can only furnish it while the water is *going down*; and your water, unfortunately, is at the bottom already. You must devise some means of getting the contents of your pond to the summit of the hill before you can derive any benefit from the descending flow; and in doing this you will expend at least as much force in raising the water as it will give back to you on its return."

It is precisely thus with all plans for obtaining light or heat, or any form of force, from the decomposition and recomposition of water. You must expend more force in the decomposition than the recomposition will restore.

GLYCERINE A SOLVENT FOR CARBOLIC ACID.

It is stated that carbolic acid for medical and therapeutical purposes should be first dissolved in glycerine, in the proportion of one part to six; it can then be diluted to any degree much more readily than when in its simple state. It forms, in its combination, a carbolate of glycerine, without having any of its properties interfered with; while the compound has certain advantageous peculiarities and remedial virtues of its own.

Among the applications of the mixture are its use for a gargle, a lotion, an injection, a disinfectant, a cure for the toothache, etc.

In many cases where carbolic acid is applied to plants for the destruction of parasitic insects both are killed. For such a purpose it is stated that a weak solution of the carbolate will insure the destruction of the latter without injury to the former.

REMEDY FOR RINDERPEST.

A Russian remedy for the rinderpest, which, it is stated, has been used with complete success upon a large number of cattle, consists in taking the skin of an animal that has died with this disease, and after wrapping 120 pounds of salt in it, placing it for a whole night before a large fire. The salt thus medicated is to be administered to healthy cattle, which are inoculated with the disease in a mild form, from which they recover in about twenty-four hours, and afterward become entirely proof against the infection.

SOME OF OUR NATIVE RESOURCES.

An English produce-broker calls attention to the fact that the leaves of the palmetto-tree, done up in bundles, and without any special preparation, are worth about $250 in gold per ton for conversion into fibre. This plant is abundant in the Southern States, and can generally be had for the gathering, and shipments of it are earnestly invited.

Another English writer refers to the anomaly shown in the exportation to America in one day of 1200 bags of Sicilian sumac, costing $125 per ton, when this article is found every where in the United States, and of a quality and commercial value from ten to twenty per cent. superior to the best European. Several species of the genus (*Rhus*) are abundant in the Middle

a string of real and fancied defects in the American system. This would be prefaced with, "You Yanks", as if an American migrant had any control over his country's policies.

When this happened in a group, the bystanders would not tell the insulting boor to shut up, as most Americans would in a reverse situation. That put the American in the indelicate position of returning the insult to the whole group, although he would prefer to repay only the individual.

I got so tired of being ganged up on like this that I became an expert on insulting Australians. If they hated Americans and wanted to take it out on me, to hell with them. One Sunday in a Sydney park, a communist was speaking to a group of wharfies (stevedores). He opened up by saying that an eagle was flying over the ocean and crapped and they called it "America". He didn't know there were any Americans in the audience. They just all went on like that.

I asked him what putrid vulture tore loose and created Australia. He started yelling at me, "If you bloody Yanks would get your thieving hands out of our pockets we could use our science to make a paradise here".

Not having my hands in any Australians' pockets I replied, "Are you so stupid as to think that these moronic wharf rats could make use of any science? They can't even read, except the cricket scores and what broken-down, doped-up Australian horse crawls across the finish line first".

The quarreling became so loud the cops hustled me out of the park. Actually, we were sort of enjoying ourselves. I was never punched, nor did I ever punch in an argument. There was no danger. But these constant, uncalled for, misdirected insults against America to Americans was a kind of national rudeness which made me want to leave.

When I got my ship, the Goonawara owned by Sweden, I was assigned to the hold seeing that the wharfies didn't pilfer. At my first friendly comment, one of the wharfies took me to task for lynching negro workers. The rest chimed in with equally absurd charges and I told them they were a bunch of goddamned communist parasites who would starve if they weren't loading American cargo.

When the bosun heard the yelling he ordered me elsewhere and put a Swede who couldn't speak enough English to understand or return any of their insults. I then took the job of second cook and got back home with fifteen cents in my pocket.

Today I'm less quick-tempered and would just consider the source when confronted by such rudeness. I could succeed in Australia now. But I'll make my stand here. I would not be beholden to people who despised me, especially for things I was not responsible for.

Americans just don't make good migrants. Our ancestors left worse conditions. As bad as you might consider things here, Americans can only migrate to places with lower living standards. Australia and New Zealand are largely dominated by American interests and their nationals naturally resent this. As decent as most of them are, all too many wish nothing but the worst for Americans, whether we deserve it or not.

States, and nearly all can be used to advantage. For this purpose the tops of the bushes are to be cut off and dried, either in the sun or by artificial heat, and then ground up, after which they are placed in bags, and are ready for market. The two poisonous kinds—the swamp sumac or poison dog-wood, and the poison oak—are of course to be let alone; but any of those with pennate leaves and producing the dark reddish-brown masses of fruit, and growing in dry places, can be collected with impunity.

PHOTOGRAPHING ON WOOD.

A new method of photographing upon wood, without danger to its surface from the use of chemicals employed, consists in transferring the collodion film, after the picture has been printed upon it, to the surface of the wood, and then dissolving the collodion by means of ether, a metallic outline being thus left that can be easily followed by the engraver.

NEW ALKALOID.

A new alkaloid has recently been found in opium, adding another to the number already known to exist in that highly complex substance. It is obtained from papaverine, and is supposed to be even more powerful in its physiological action than morphine.

GLYCOGEN.

Starch, as such, is no longer to be considered as peculiarly vegetable, since a certain form of it, called glycogen, first discovered in the liver, is now claimed to be a regular constituent of muscle, and believed to be consumed in muscular action, thus forming the fuel with which the muscular engine is worked.

HYPOSULPHITE OF SODA IN WASHING.

A German chemist advises washer-women to use hyposulphite of soda, instead of the common carbonate of soda, as it does not attack fabrics in any way, while it exerts a certain bleaching action, which greatly improves the appearance of white goods.

POISONOUS CHARACTER OF METHYL-AMMONIUM COMPOUNDS.

Rabuteau has ascertained that the iodide of methylammonium and the iodide of tetramyl-ammonium act upon animals precisely like the curare poison, by destroying motions without affecting the sensibility, and with precisely the same subtilty and energy. A few centigrammes will kill a dog in a few minutes.

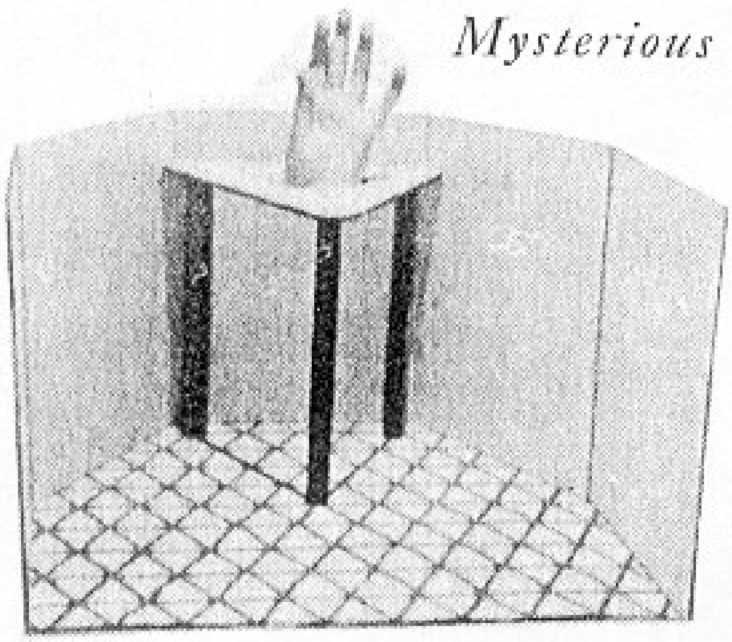
AMMONIA ENGINES.

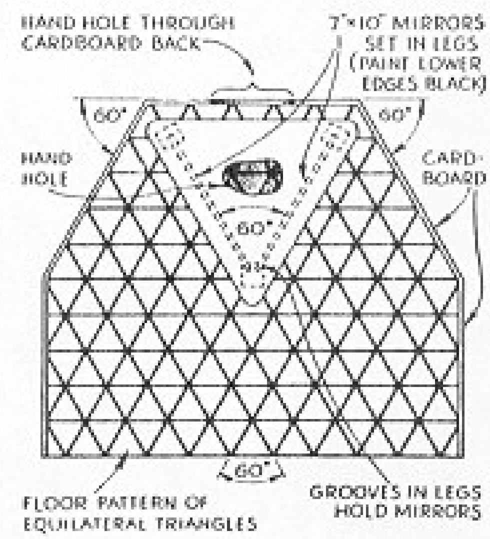
The Abbé Moigno claims for France the discovery of the applicability of ammoniacal gas as a motive power, and cites a communication of Tellier, the well-known inventor of the ice-machine, to the Academy of Sciences at Paris, made some time ago. In this article it is stated that the availability of ammonia for the purpose consists, first, in its great solubility in water; second, in its ready liquefaction; third, in the faculty which it possesses of furnishing industrial pressure at the ordinary temperature; fourth, in the possibility of superheating its vapor without reaching too high a temperature; and fifth, in the possibility of collecting the vapors expended by their solution in water, and then recovering them again, to be used anew in the operation. The more important applications of this gas, he thinks, will be in railroad traveling, for the purpose of working high grades, and as a motive power in tunnels, where smoke and burned air would not be desirable; also in mines, and in the minor industries, where a cheap and safe motive power is needed.

Tricks You Can Do with Mirrors

Popular Science Monthly — December 1935

Mysterious Living Hand





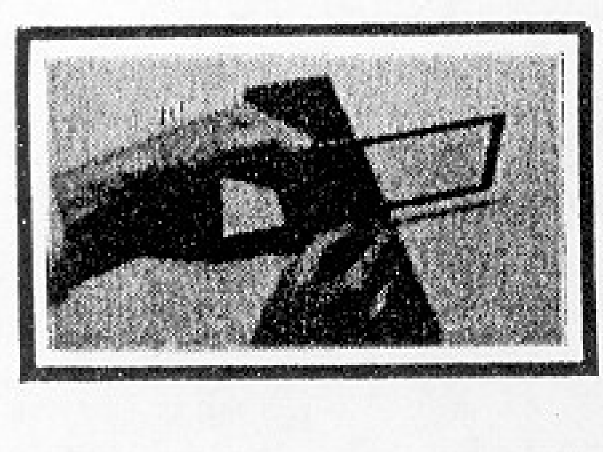
A HUMAN hand, apparently detached from the body, moves mysteriously atop a three-legged table in this startling illusion. Mirrors set between the legs of the table reflect the images of the screen and floor to give the effect of empty space. The hand is passed through a hole in the back screen, and up through a hole in the table.

Magic Bank Makes Deposits Disappear

YOU can mystify your friends with this trick bank. Let them inspect it and see that there are no secret compartments—only what appears to be a transparent partition of plate glass dividing it in the middle. This is really a pair of thin mirrors placed back to back and bound at the top with passe partout binding tape. Each mirror reflects half of the box and, no matter how you look at it, the partition seems to be transparent. Note how the pencil, in the photograph, disappears behind the glass. The cover is placed over one compartment and a coin is dropped through the slot. To the observer, the coin appears to vanish completely.

Mirror Used as a Square

To draw a line at right angles with the edge of a board, hold a mirror as shown. When the reflection coincides with the board itself, the mirror is square with it.



IMITATION OF MAHOGANY.

A method is now in use in Paris by which almost any kind of wood of close grain can be made to imitate mahogany so closely as to render it almost impossible to distinguish between the real and false article. The wood is first planed so as to render it perfectly smooth, and is then rubbed with dilute sulphuric acid. Afterward an ounce and a half of dragon's-blood dissolved in a pint of alcohol, and half that quantity of carbonate of soda, are mixed together and filtered, and this liquid is then rubbed, or rather laid, on to the wood with a soft brush. This process is repeated until in a short time the wood will be found to have the appearance of mahogany. A little cold-drawn linseed-oil will restore the polish, which becomes dimmed. It is said that this substitute is now applied with success in Paris to all purposes for which mahogany was formerly used.

PARCHMENT-PAPER.

The use of parchment-paper for the preparation of deeds and other purposes is increasing very rapidly, and is replacing the genuine parchment in a great many of its applications. An improved method of preparing this substance, according to a late article, consists in using the commercial oil of vitriol in an undiluted state. The paper is first passed through a solution of alum, and thoroughly dried, previous to its immersion, thus preventing any undue action of the corrosive principle of the vitriol. After the application of the acid the paper is passed into a vat of water, and then through an alkaline bath, to be again washed. Written and printed paper may undergo this improved process without materially affecting the clearness and distinctness of the letters, and the paper retains all its qualities, even after being wetted several times in succession, while paper prepared in the usual manner loses, to a great extent, its pliancy, and becomes hard and stiff.

NICKEL AND COBALT PLATING IN THE WET WAY.

Professor Stolba, of the polytechnic laboratory of the Polytechnicon, of Prague, a chemist who has been the first to announce to the world several important technical discoveries, especially in reference to the plating of metals, has just published, in Dingler's *Polytechnic Journal*, an article upon the method of coating metals of all kinds with nickel and cobalt in the wet way, or by boiling; and he thinks that it will be quite possible to imitate the effect of, and even to furnish a satisfactory substitute for, the method by electroplating, which has lately come so generally into use.

The value of nickel plating is, of course, well understood, and it is now very much used wherever polished iron or brass is liable to corrode, as is particularly the case in the vicinity of salt-water. In large yachts, where expense is no consideration, all the metal work, as also the machinery of sea-going steamers, is often treated in this way; a notable instance of which may be seen in the yacht *Resolute*, a splendid vessel lately built for Mr. A. S. Hatch, of New York.

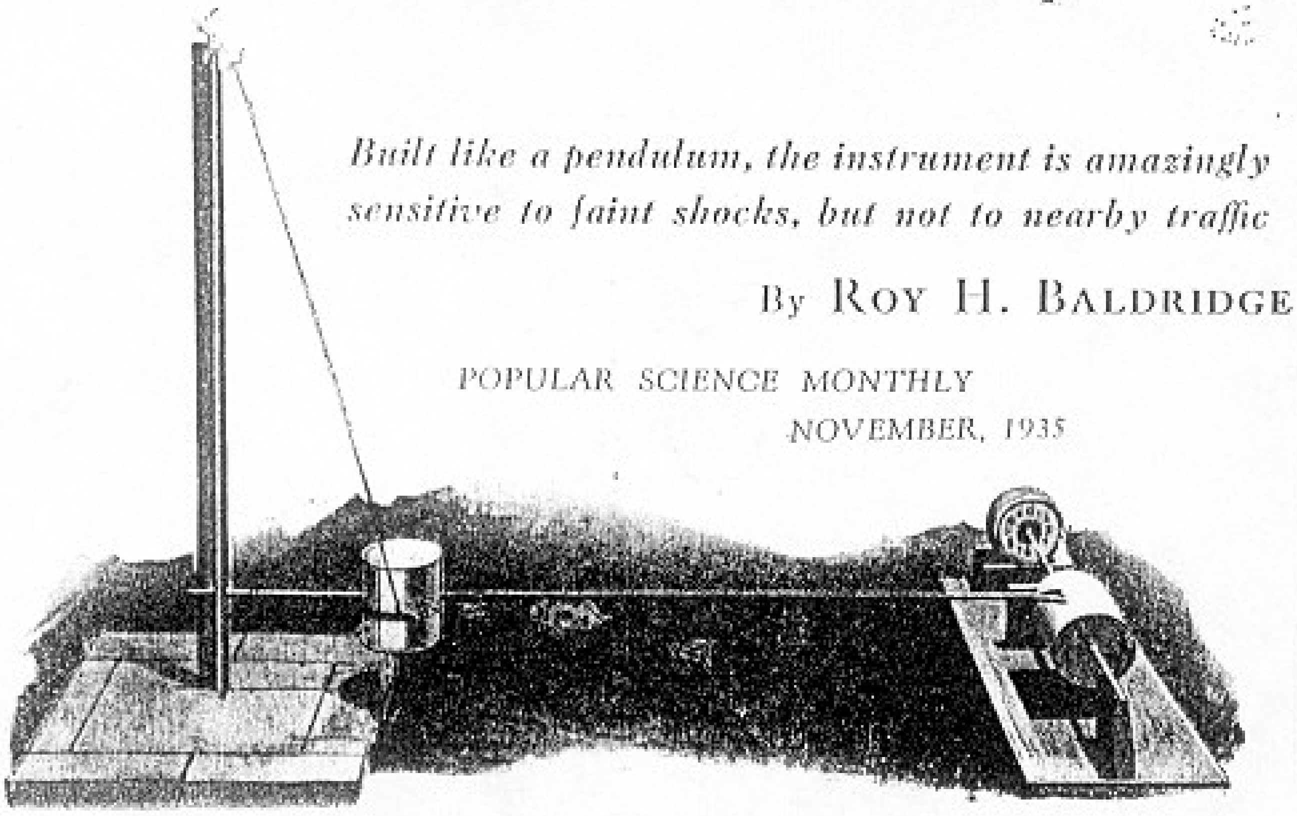
The details of Professor Stolba's process are too complicated for our pages; but we may say, in general terms, that it depends upon the action of salts of nickel in the presence of chloride of zinc and of the metal to be coated. The substances required are: first, a suitable vessel for conducting the operation, which may be of porcelain or metal; second, a suitable salt of nickel, which may be either chloride, sulphate, or the sulphate of nickel and potassa; third, a solution of chloride of zinc; fourth, clippings of sheet zinc or zinc wire and powdered zinc; fifth, pure

EASILY MADE SEISMOGRAPH Records Distant Earthquakes

Built like a pendulum, the instrument is amazingly sensitive to faint shocks, but not to nearby traffic

By ROY H. BALDRIDGE

POPULAR SCIENCE MONTHLY
NOVEMBER, 1935



Complete seismograph and recorder. Earthquakes from 200 to 6,100 miles away have been registered

THIS very instant the ground trembles beneath your feet. The earth's crust, seemingly, is never at rest; and somewhere in the world, perhaps in the center of a continent, possibly beneath some ocean, a quake is in action that may send its vibrations around the globe. For sheer unbelievable, horror-tinged experience, with the terror of a nightmare imposed on reality, there is nothing quite like a stiff earth shock. To the accompaniment of low-pitched rumbling, the ground writhes, trees sway, and buildings crash, while the sickening realization comes that there is no rigid thing left to which you can cling for support.

No one knows when or where an earthquake will occur. For this reason scientists are studying earth movements, and have learned much of the nature of such disturbances, as well as what can be done to lessen damage from them.

By building a seismograph similar to the one illustrated, you can make a hobby of quake recording yourself. You may have to wait only a few hours after completing it to check up on a shock, and at most only a few days will elapse. My seismograph has recorded forty-three earthquakes within six months, varying in distance from 200 to 6,100 miles. Although it is located within 75 ft. of heavy street traffic, no bad effects are noticeable.

This instrument consists of a horizontal pendulum suspended by a fine wire from an upright post in a heavy foundation. When the earth trembles, the bob, freely suspended, remains almost still while the post and pivot vibrate. A delicate point at the end of a long, light arm fixed to the bob magnifies the movement of the ground and scratches the record of it on a smoked paper wrapped around a revolving drum.

The post is an angle iron drilled as detailed in the drawing. Set it up in a concrete foundation about 16 in. square and 9 in. high; or a shell of bricks may be built up, and concrete poured in the center. While this hardens, make the other parts.

The bob, or weight, is of lead, melted and poured into a can about 3 by 3½ in. The dimensions may vary somewhat. If the can is packed in damp sand, the hot metal will not run out when the seams open.

In the center of the side of the weight, drill and tap a ¼-in. hole, ¾ in. deep. Thread a ¼-in. brass rod 5 in. long at one end to screw into the bob, and if it is too loose, make a few dents in the lead. Cut off the end of the rod so that the distance to the center of the weight is 5¾ in., and drill a hole in the end slightly larger than an extra-loud phonograph needle, of such depth that the inserted needle will be exactly 6 in. from the point to the bob center. A little solder melted into the hole around the needle will fasten it.

In the center of each side of the weight, at right angles to the rod, drive a small finishing nail, allowing the head to pro-

hydrochloric acid. Cobaltizing, as Professor Stolba terms it, is conducted in very much the same way—a salt of cobalt being used in place of the salt of nickel.

SUGGESTION FOR DISPENSING WITH SMOKE-STACKS.

Rev. Mr. Gibsone proposes a method for dispensing with smoke-stacks—namely, by having a downward flue terminating in the water-drains. He maintains that if the drains of any district are connected with a ventilating furnace having a lofty ornamental shaft, there would be at once obtained the motive current of air, and a means of destroying the noxious gases of our underground system, while the central furnace would supply warm air or water, or even gas, to all the contiguous dwellings, and the heavy fuliginous matters would be condensed chiefly in the sewers. The result would be, first, absence of smoke in a city atmosphere; second, diminution of cost in construction of various chimney-stacks; third, absence of architectural disfigurements, such as zinc cowls and red cylindric pots; fourth, saving of fuel by total consumption of the smoke in the grate, the fire burning downward instead of upward; fifth, greater ease in cleansing the flues from soot, and in the removal of ashes; sixth, steadiness and irreversibility of air draughts, and power of thoroughly ventilating a room even when unfurnished with a fire.

To this the editor of the *Chemical News* rejoins that the idea is not a novel one, the same thing having occurred many years ago to Mr. Spence, of Manchester, but the difficulty of getting sufficient draught was so great that it could not be carried out. A tower of an impracticable diameter would have to be erected, and the leakages into the sewers would be so numerous that, at a distance of 100 yards from the tower, no appreciable effect would be produced.

CAUSE OF SMOKINESS IN QUARTZ CRYSTALS.

Mineralogists are well aware that in 1868 a large number of crystals of smoky quartz were found in Switzerland, which furnished specimens of great beauty and size to many cabinets throughout the world. In the course of an investigation into the physical characters of some of these crystals, it was found, much to the surprise of the experimenter, that on heating they lost their smoky appearance, and became as limpid and colorless as the most beautiful rock crystal; and this suggested the inquiry whether the color was due to the inclusion of organic substances which were destroyed by heating, or to some change of the molecular constitution of the crystal caused by the heat. To determine this question, Professor Forster subjected a series of these crystals to a careful examination, and, as the result, came finally to the conclusion that the black color was not the result of any peculiar molecular condition, but that it was produced by the presence in the crystal of bodies containing organic carbon and hydrogen.

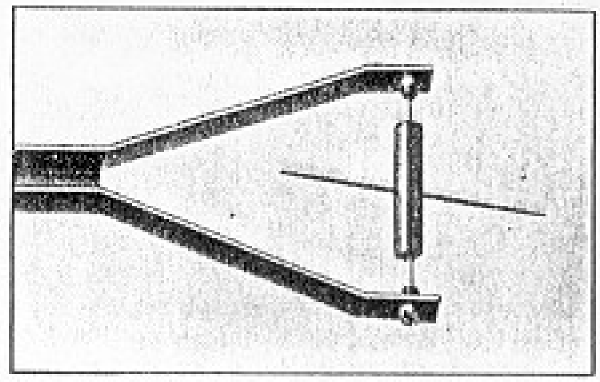
NEW REDUCING AGENT.

If an aqueous solution of sulphurous acid be allowed to act upon fine zinc dust, the zinc is dissolved without the development of gas, the solution assuming for a time a decided yellow color. This liquid now possesses the peculiarity in a very high degree of rapidly decolorizing indigo, a fact well known to chemists. Schützenberger, who has lately been investigating this subject anew, ascertained that this decolorizing of the indigo is by no means the result of oxidation, but, on the contrary, is a reduction; and this power of reduction in the liquid is so extraordinarily great that it will reduce, with heat, the

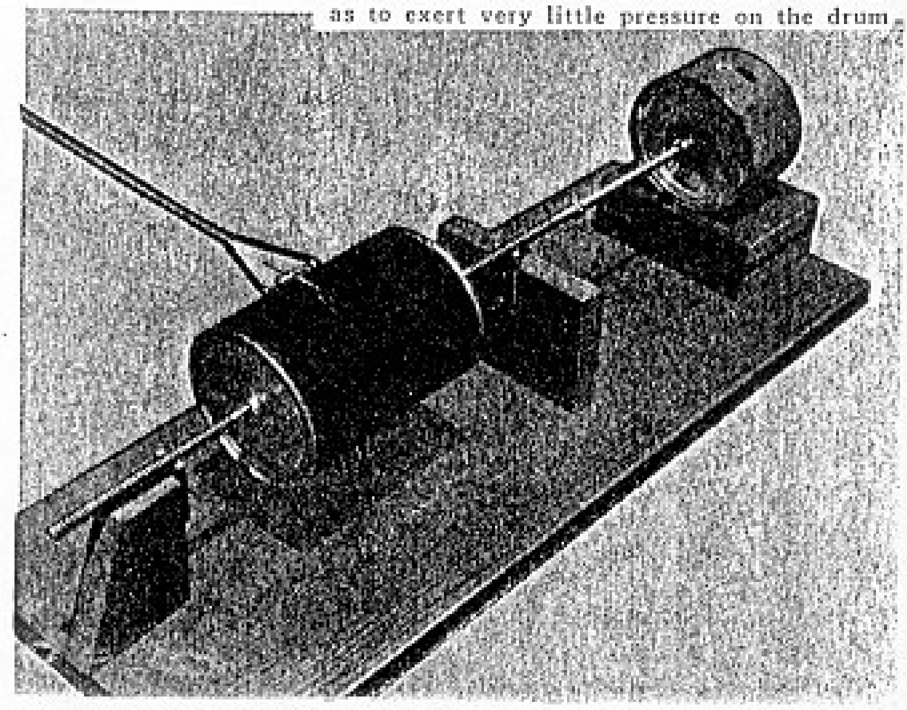
ject about ¼ in. Attach a stirrup of No. 14- or 16-gauge iron wire to these nails with loops, and tie the suspension wire to the center, thus bringing the point of suspension to the center of the bob.

Three adjustment points are provided in the seismograph. The upper, or wire adjustment (*A* in the diagram) consists of a threaded brass rod bent L-shaped and pierced with a small hole. It is screwed into a bracket consisting of a brass plate with the upper end bent back at a little more than 45 deg. A lock nut behind the bracket keeps the adjustment rod from changing position.

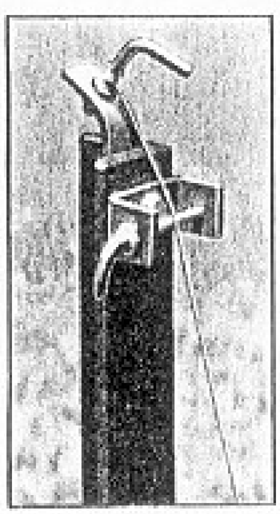
Adjustment B, for shifting the upper support sidewise, is a piece of ⅛ by ¾-in. brass bent U-shaped, with a 3/16-in. threaded brass rod running through the ends. The U is not threaded, serving merely as a bearing for the rod, which is kept from end motion by two



A detail photograph of the stylus mounting. Note that the needle is counterbalanced so as to exert very little pressure on the drum

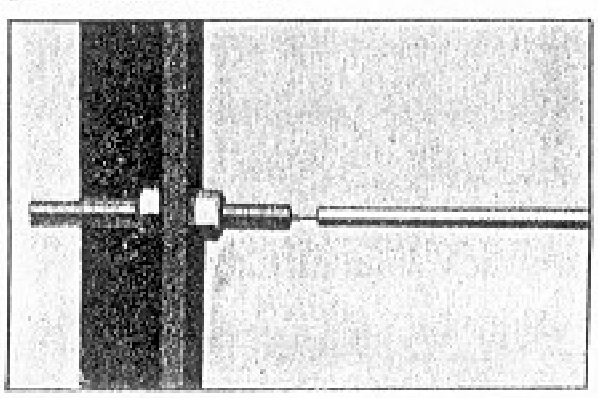


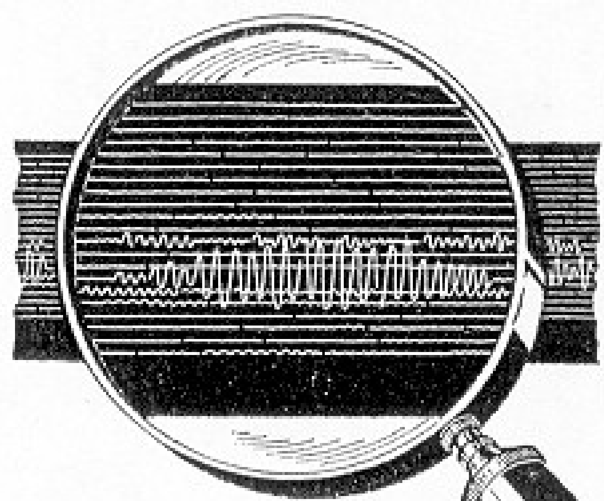
The stylus rests on a drum made from a can and covered with smoked paper. A threaded shaft draws the drum endwise as the clock turns it



Close-up of top of post showing method of adjusting the wire accurately in respect to length and position. These parts are marked *A* and *B* in the drawing

Below is the pivot and the adjustment that is marked *C* in drawings. A cone cup bearing from an old clock balance wheel and a phonograph needle form the pivot





Tracing of actual record made by the stylus of a quake 5,920 miles away

nuts that are soldered to the rod after being tightened against the U. The U, together with the bracket for *A* adjustment, is fastened to the post with a ¼ by 1-in. machine bolt.

Adjustment *C* is made of ⅜-in. brass rod threaded full length, with a slot cut in the rear end for a screw driver. To the other end solder a cone cup bearing from an old clock balance wheel, as a pivot for the phonograph needle in the bob rod. Supply the adjusting screw with a nut before and behind, after inserting it in the lower hole of the upright, and tighten it with the cup bearing about ½ in. from the surface of the post.

Make the extension arm of 30-gauge aluminum, forming it into a tapered channel by folding up the sides as indicated. The small end terminates in a Y formed by cutting out the bottom and spreading the sides to accommodate the stylus assembly.

For attaching the arm to the weight, make a sheet-brass clamp ½ in. wide and 10 in. long to bind around the bob, where it is held with a screw and nut in the

salts of copper, silver, and mercury to their metals. The liquid is not related to hydrosulphuric acid, and is exceedingly unstable in its free condition; but if a concentrated solution of bisulphite of soda be allowed to act upon the zinc filings, we shall obtain a soda salt of the new acid which has as great an affinity for oxygen as the free acid, and can, therefore, be kept for any length of time if completely excluded from the air.

IMPROVED STOVE.

When the last German arctic expedition was about preparing for its voyage to the north pole Captain Koldewey asked the aid of scientific men in devising a stove that would answer the double purpose of supplying a sufficient amount of heat and of economizing the fuel. Various responses were made to this appeal, and among the patterns furnished that of Professor Meidinger, of Carlsruhe, was considered the best. This is simply an iron stove having a double wall, with a space about two inches wide between the outer and the inner one, to which the air has free access above and below. The cold air being always at the bottom, and the warm air ascending, it follows that all the air in the room is being constantly forced through the space between the outer and inner covering of the stove; or, what is the same, is being constantly heated. Connected with this is another ingenious device. The coal is put in from the top, and fills the whole inside of the stove, which is about six feet high, more or less. It is then lighted at the top, and kept burning by the draught created by valves inserted both in the side walls and at the bottom of the stove. The more valves that are open the greater the heat, so that the temperature of the room can be regulated to a nicety. At the same time the outer wall, being at a distance from the inner one, never reaches the excessive heat which is so great an objection in ordinary iron stoves. The expense of fuel to produce a sufficient amount of heat is very much less than that for ordinary stoves, and the new invention is rapidly coming into use in Germany.

CLEANING DIATOMS.

An improved method of cleaning and bleaching diatomaceæ is stated by Dr. Maddox to consist in dissolving forty grains of crushed chlorate of potassa in water, with the addition of one and a half drams of hydrochloric acid, the whole to be placed in a three-ounce vial, and closed with a wax cork. The diatoms are to be immersed in this for a suitable length of time, and subsequently washed out with clean water.

MINERAL COTTON.

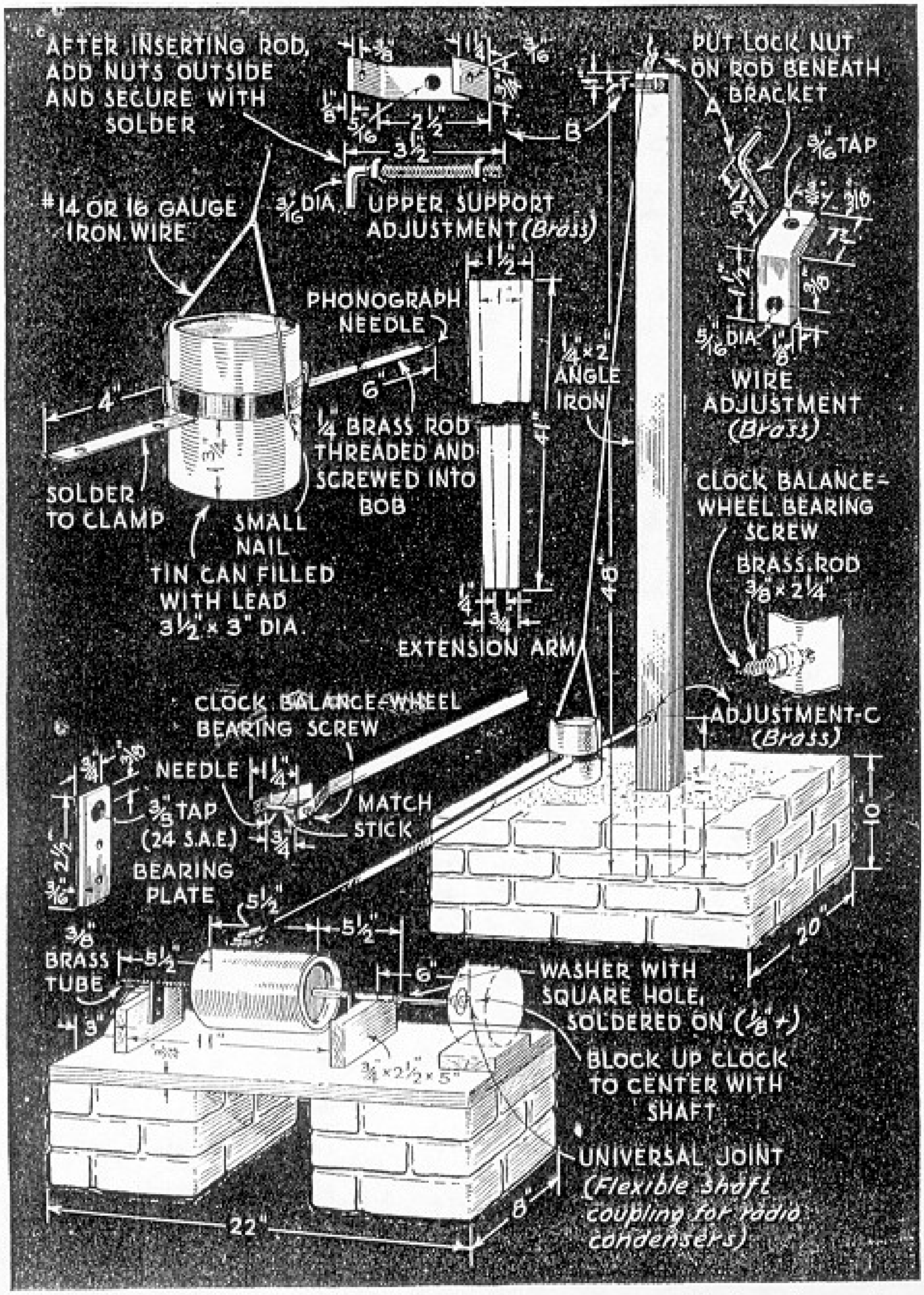
The Journal of the Franklin Institute reports the exhibition at one of its meetings, by Mr. Coleman Sellers, of a material which it is thought may be capable of useful applications in the arts. The substance possesses a general resemblance to cotton, for which it may in some cases probably be used to advantage. It is really, however, a form of spun glass, produced by allowing a jet of steam to escape through a stream of liquid slag, by which it is blown into the finest threads, sometimes two or three feet in length. These threads, though somewhat elastic, readily break up into much smaller ones, and the color of the substance being white, the appearance of a compacted mass of it makes the name of mineral cotton, under which it has been described, a very appropriate one. The admirable non-conducting property of the material for heat, as well as the great quantity of air it retains in its interstices, would seem to fit it very well for a non-conducting casing to steam boilers and pipes, an application for which it is being tested.

bent-out lugs, as shown. A strip of brass ½ by 4½ in., with ½ in. at one end bent at right angles, is soldered to the clamp and fastened to the extension arm with two small bolts.

To assemble the machine, thread the suspension wire (a fine music wire, such as a guitar E-string) through the hole in adjustment rod *A*, and rest it between threads on adjustment *B*. Turn *A* until the pendulum, with the needle tip in the bearing of *C*, is horizontal from the bearing to the bob center. The weight should come to rest with its rod at right angles to the face of the angle iron, the necessary adjustment being made by turning the rod of *B*.

You now have a horizontal pendulum with a definite period of oscillation. The period is the time in seconds required for the weight to make a swing back and forth. With the pendulum in motion, and using the farthest movement to the right as a starting point, check the time in seconds required for the weight to move to the left and back to the starting point again.

After your first adjustment, the period will probably be six or eight seconds. To change it, shift the pivot outward, nearer a point directly below the upper support, by loosening the nut on the rod behind the angle iron and tightening the front one. Continue moving the pivot outward



How the seismograph is set up and details of the more important parts. The dimensions are those of the original instrument constructed by Mr. Baldridge and thoroughly tested over a long period

until the pendulum has a period of twelve seconds.

If the seismograph is placed out of doors it should be in a dry, shady spot, and a larger foundation should be used, or water seepage under the foundation will cause the needle to wander off the paper. Place a screen around the instrument to prevent the wind from blowing directly on the pendulum, which is very sensitive to air currents around it. If the currents are very troublesome, the seismograph should be entirely inclosed.

The recording drum is simplicity itself. Obtain a tin can of about the size indicated and mount it on a ⅛-in. brass tube for a shaft. One end of it is threaded, while the other is left smooth and terminated by a washer having a square hole in it slightly more than ⅛ in. on a side.

Bearings are made by drilling bar brass to receive the shaft and mounting screws. Drill one 7/16 in. in diameter and thread it to fit the shaft threads, but drill the other ¾ in. for a plain bearing. Having cut off the ends, screw the plates to wooden mounting blocks, which in turn are held upright by a base board. If the drum is rotated, it will be drawn endwise corresponding to the lead of the screw, and thus a continuous line is traced by the stylus. Driven one revolution per hour by a small electric clock, the paper will last several days without changing.

Block up the clock until central with the tubing. Remove the hands, and attach a radio universal joint to the hour-hand shaft. To the other side secure a steel rod ⅛ in. square, having its other end thrust through the shaft washer, thus providing a drive for the drum, no matter what its endwise position.

THE drum assembly must be blocked up to such a height that the drum is a little below the level of the extension arm tip.

Friction between the stylus and the paper on the drum must be reduced to a minimum, and this is accomplished by the use of a counterbalanced needle. Cut a match stick ¾ in. long, cut two small sewing needles in half, and put the pointed halves in the ends of the stick. Run another small needle through the center of the match so that a cross will be formed. It is the point of this needle that traces the line on the smoked paper.

For pivot bearings, make a small hole in each side of the Y with an ice pick, and screw in two clock balance-wheel cups. Mount the stylus pivot between them. After a few trials the tracing needle can be balanced so that the point will rest very lightly on the paper.

Highly glazed paper, such as enamel-finished book paper, should be used for the record, since its smooth surface will hinder the movement of the needle but little. Almost every printing shop carries some in stock. Use a kerosene lamp to smoke the paper, turning the flame high and holding the paper above it until a black deposit of soot has been deposited.

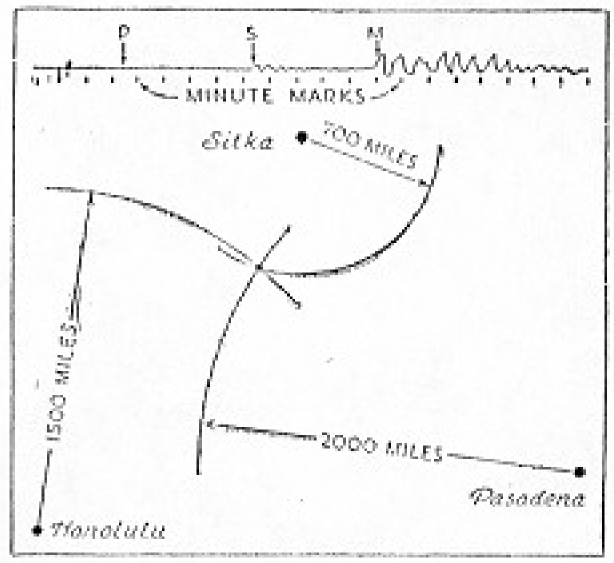
Sometime during the recording, mark the position of the stylus at 12 m., so that time can be reckoned from it. After recording, fix the sheet by spraying it with a solution of six parts alcohol to one of white shellac, and use it as a negative, if desired, for printing the permanent record on photographic paper.

The seismograph, of course, will register only shocks that vibrate somewhat out of the plane of the post and arm. To receive quakes from all directions, two instruments should be built and set up at right angles to each other.

When there is no disturbance, the pendulum will remain stationary and the needle will trace a straight line on the smoked paper as it moves beneath it; but when waves from a distant quake pass beneath, the needle will swing from side to side, sometimes less than ⅛ in., sometimes 1 or 2 in. Large or small, each line will create a desire to learn more about the science of seismology.

HAVING obtained a record, you will want to know the distance and location of the earthquake. The distance can be estimated fairly accurately. Avoiding technicalities, it may be said that three main waves emanate from the usual shock. The first, or primary (P) wave travels fastest. A slower secondary wave (S) comes a little later, registering on the paper, and later still a third, or main (M) wave. They start together, and diverge more and more as they travel from the source, and their rate of travel has been measured. Thus charts have been prepared that show from the time-separation of the recorded waves the distance to epicenter, or the area of ground immediately above the disturbance.

The location of a quake is learned by obtaining a card from the U. S. Coast and Geodetic Survey giving the data, or it can be computed from the records, as illustrated in the diagram.



Three-station method of computing location of an earthquake. Each station calculates the distance by the variation of the wave time; then scale radii are used to strike arcs, all of which intersect at the epicenter

ANTAGONISM OF BELLADONNA AND PHYSOSTIGMA.

According to Dr. Frazer, the active principle of belladonna (atropia) has a remarkable counteracting influence upon the poisonous action of the Calabar bean (physostigma). When doses of atropia were given a few minutes before or after taking the bean, animals recovered from the effects, which would otherwise have been fatal, the most successful result being when the atropia was given before taking the bean.

GUATEMALA AS A RESORT FOR CONSUMPTIVE PERSONS.

A recent communication by Dr. James Wynne, of Guatemala City, to the Royal Medical and Chirurgical Society of London, calls attention to the advantages of the Pacific coast of tropical America, and especially of Guatemala, as a residence for consumptive patients. This city is situated 5000 feet above the sea, in latitude 14° 37′ 32″ north, having a mean temperature of 66° F. The climate is that of perpetual spring; the air is tonic and invigorating, yet not too stimulating. Consumption is very rarely met with, and phthisical patients coming from a distance, if able to lead an open-air life, make remarkable progress. Of twelve cases recorded, four died, five recovered, while three still remained under observation. Of the fatal cases, the disease had reached a hopeless stage in all but one, before being seen for the first time. It is suggested that the value of the Central American plateaus in phthisis should be tested by sending out twenty patients in an early stage of the disease for a few years, or, better, for a permanent residence.

SILVERING OF GLASS PLATES AND GLOBES.

According to Krippendorf, the silvering of glass plates may be readily accomplished by the use of the following substances: 1. Sodio-potassic tartrate; 2. A two per cent. solution of this salt; 3. Caustic ammonia; 4. Solution of silver nitrate, 1:8 (old silver bath will serve). From these the silvering and reducing liquids are prepared.

The reducing liquid is prepared by taking 900 cubic centimeters of distilled water, and 90 cubic centimeters of the solution of the tartrate, and, after mixing, boiling strongly together, and while the steam is issuing violently from the flask, dropping in 20 cubic centimeters of the silver solution, and boiling for another ten minutes. This solution not only keeps, but seems to improve by age. The liquid is to be filtered from the precipitated silver as it is wanted.

The silvering solution is prepared by taking 900 cubic centimeters of distilled water, and adding 80 cubic centimeters of the silver solution and 100 drops of the ammonia solution, and filtering if necessary.

For silvering, equal volumes of the two solutions are to be carefully and separately filtered, and poured together into a flat glass dish to such a depth that the thoroughly cleansed plate shall be covered by a layer of at least one-tenth of an inch. Decomposition of the mixture takes place in ten minutes, and pure metallic silver is deposited on the plate, which is then washed, dried, and varnished. For the purpose of silvering the interior of glass globes, etc., it is sufficient to pour in successive small quantities of the mixture, turning the vessel continually, so as to keep the whole surface wet uniformly.

DIFFERENCE OF BACTERIA FROM FUNGI.

Some researches by Dr. Sanderson upon the intimate pathology of contagion have led him to very careful investigations into the conditions under which microzymes (Bacteria) and fungi become developed in various solutions. The results at which he arrives are of great importance. Microzymes are not capable of being transmitted from one solution to another by means of air. On the other hand, fungi, as is well known, are capable of being so transmitted. If proper precautions in its preparation be taken, a solution (Pasteur's, *e. g.*) may be exposed to the air for months in an open vessel without the development in it of a single Bacterium, while fungi (*i. e., Mycelium torula*) will be developed in it in proportion to its amount of exposure to the air. In order to insure this result, all that is necessary is to boil the solution, and thoroughly rinse with boiling water the vessel that is to contain it.

The addition of a drop of ordinary distilled water is sufficient to cause rapid development of Bacteria in abundance in such a solution. If

the distilled water be previously boiled, no such development ensues. These results show clearly that there is no developmental connection between microzymes and *torula* cells, and that their apparent association is one of mere juxtaposition.

There is also in this paper an account of a series of experiments with sealed tubes containing organic and other solutions, which were, as in Dr. Bastian's well-known experiments, submitted to a high temperature, special experiments being also made with tubes in which more or less perfect vacuum was produced; Dr. Bastian, as it will be remembered, believing he had found that low organisms developed themselves more rapidly in fluids existing in an atmosphere of low tension. Dr. Sanderson's conclusions are entirely at variance with those of Dr. Bastian. In no one case where proper precautions were taken to exclude and destroy germs did any development of life whatever take place.

RICHARDSON'S HYPOTHESIS OF A NERVOUS ETHER.

In a late number of the *Popular Science Review* Dr. Richardson again brings forward his favorite theory in regard to a nervous ether, namely, that between the molecules of the animal matter, solid or fluid, of which the nervous organisms, and, indeed, of which all the organic parts of the body are composed, there exists a fine, subtile medium, vaporous or gaseous, which holds the molecules in a condition for motion upon each other, and for arrangement and rearrangement of form; a medium by and through which all motion is conveyed, and by and through which the one organ or part of the body is held in communion with the other parts, and by and through which the outer living world communicates with the living man; a medium which, being present, enables the phenomena of life to be demonstrated, and which, being universally absent, leaves the body dead—that is, in such condition that it can not, by any phenomenon of motion, prove itself to be alive.

According to the doctor, the evidence in favor of the existence of an elastic medium pervading the nervous matter, and capable of being influenced by simple pressure, is perfectly satisfactory. Numerous experimental facts suggest that there exists in the nerves an actual material mobile agent—a something more than the solid matter which the eye can see and the finger touch. He therefore is led to believe that there is another form of matter present during life, which exists in the condition of vapor or gas, which pervades the whole personal organism, surrounds, as an enveloping atmosphere, each molecule of nervous structure, and is the medium of all motion communicated to or from the nervous centres.

The source of this refined matter in the body he considers to be the blood, and he looks upon it as a vapor distilled from the blood, as being persistently formed, so long as the blood circulates at the natural temperature, and as being diffused into the nervous matter, to which it gives quality for every function performed by the nervous organization. In the closed cavities, containing nervous structure, the cavities of the skull and spinal column, this gaseous matter, or ether, as he terms it, sustains a given requisite tension; in all parts of the nervous structure it surrounds the molecules of nervous matter, separates them from each other, and yet is between them a bond and medium of communication.

In estimating and defining the physical properties of this nervous ether he suggests that it is a gas or vapor, having in its elementary construction carbon, hydrogen, and possibly nitrogen. He thinks it is condensable under cold, movable

Warnings From The Past

By Kurt Saxon Copyright 1982

The imminent collapse of world civilization is becoming apparent to more people as the economy grinds down and international frictions accelerate. Even so, most people still believe the overall decline is due to some kind of plot, political bungling or economic miscalculation.

Whatever they believe, they are still blind to the real root cause of every socio-economic and political upheaval; a surplus of people, and worse, a surplus of inferior people. Further, they seem to think it Hitlerian to advocate the destruction of the millions of parasites who have doomed civilization.

Actually, Hitler's program was plain and simple nationalism, whereby the German was to be supreme over every other race and ethnic group. Much is made of his proposed program to sterilize defectives. But this only involved obvious mental basket cases. Any German able to tell the difference between one end of a gun and the other was to become part of the "Master Race". The uniformed Germanic ape would have been placed over even intelligent Americans.

Hitler's bias in favor of Germans over the superior Americans and British of his day stems from his being an Urbanite and a politician. If any bias is valid I'd favor the most dim-witted but productive clod kicker in the Ozarks over any Urbanite and/or politician.

I bring up Hitler only because I'm so often accused of imitating his thinking in my advocacy of sterilization and euthanasia in regards to ridding our species of inferiors.

My only concern in ridding our species of inferior people is a kind of insurance. This is that all of our citizens will be well born, well reared, well educated and well occupied. Plus, without morons dropping surplus young onto the welfare rolls, adequate individuals could keep most of their earnings for the benefit of themselves and their loved ones. Regardless of the socio-economic system, there is no justification for public funds being squandered on demanding parasites.

Our present horde of public charges has become an accepted obligation on the part of the average American taxpayer. Every politician falls all over himself apologizing for any fancied slight to "the truly needy". But who truly needs the truly needy? Any why should the truly needed be enslaved on their behalf? Why should the lives of the improvident aged be prolonged by strangers? Why should the fertility of welfare parasites be subsidized by society's workers? There is no logical reason for any of these miscarriages of compassion.

But modern Urbanites have become so psycologically and economically locked into the system of perpetuating the useless and unfit that it will take a nuclear war to rid us of them. It does no good to try to reason with Urbanites since they're unable to grasp the basic issues.

In case it's not clear in your mind, let me give you a few simple illustrations which I hope will put the problem in its overall perspective.

Say this country was a body and the people were its cells. Say further that over a third of the cells were either old and worn out or physically or mentally defective, or predatory, attacking normal cells.

Now, say your doctor said you had cancer and he was going to cut it out. But you say, "No. My cancer cells have as much right to live as my normal cells". You'd be judged insane.

But our country has millions of old people, being kept alive artificially, in misery, long after Nature/God decreed they should die, and at great public expense. Millions of physical and mental defectives are not only allowed to live, but encouraged to reproduce their blighted kind; again at great public expense. Millions of predators, with known records, are allowed to run free to rob, rape, maim and kill; still at staggering public expense. If jailed,

under pressure, diffusible by heat, insoluble in the blood, and holding, at the natural temperature of the body, a tension requisite for natural function. In his opinion it is retained for a longer time after death in cold-blooded than in warm-blooded animals, and longer in warm-blooded animals that have died in cold than in those that have died in heat.

It is not, according to his idea of it, in itself active, nor an excitant of animal motion in the sense of a force; but it is essential as supplying the conditions by which the motion is rendered possible; as serving as a conductor of all vibrations of heat, light, sound, electrical action, and of mechanical friction. It holds the nervous system throughout in perfect tension during perfect states of life. By exercise it is disposed of, and when the demand for it is greater than the supply, its deficiency is indicated by nervous collapse or exhaustion. It accumulates in the nervous centres during sleep, bringing them to their due tone, and thus rousing the muscles to awakening or renewed life. The body, fully renewed by it, presents capacity for motion, fullness of form, and life. The body, bereft of it, presents inertia, the configuration of "shrunk death," the evidence of having lost something physical that was in it when it lived.

TREATMENT OF SMALL-POX SUBJECTS.

During the prevalence of small-pox in Paris last spring the police authorities required the bodies of those dying from it to be sponged in a liquid composed of one hundred and eighty grains of carbolic acid in a quart of distilled water. Formerly chloride of calcium was used; but this had the great inconvenience of rendering it almost impossible for any one to remain in the room with a corpse. The carbolic acid solution in question is said to have all the advantages of chloride of calcium with none of its inconveniences.

EXTRACTING JUICE FROM SUGAR-CANE, ETC.

A new method of extracting juice from sugar-cane, beet-root, etc., by the process of diffusion, has been announced in the foreign journals. For this purpose the cane, or other original substance from which the juice is to be extracted, is to be first cut in slices by a special machine, and then placed in a series of closed water-tight tanks, and brought in contact with water at an elevated temperature in a certain succession and systematic order. Another method consists in carrying out the whole process of diffusion in a single vessel, in which the extraction of the sugar is carried on continuously by introducing slices of cane through a feeding apparatus at the bottom of the vessel, from which they rise slowly to the top, while fresh water is constantly running in at the top of the diffusing vessel, and is drawn off at the bottom, as diffusion juice, after having remained in contact with the slices for a certain length of time. The liquid during the operation is agitated by machinery. It is suggested that this process may be applied on a small scale in domestic operations in making such drinks as lemonade, etc.

PERMANGANATE OF POTASH FOR COLDS IN THE HEAD.

We find continued mention made in the foreign journals of the value of permanganate of potash as a remedy in cases of cold in the head attended with severe sneezing. For use in such cases a solution is prepared of about one and two-thirds grains of the permanganate in two fluid

they often live better than their victims, to the detriment of the taxpayer.

So this country is afflicted with collective insanity and terminal cancer. The terminal cancer is self-explanatory. But the collective insanity is manifested in the average Urbanite's ignorance in believing in the timelessness of today.

The Urbanite's mind is beset with thousands of impressions each day. Rapid change is a natural part of his life. His days are so full of differences, he can't remember well what life was like five years ago, much less twenty. And history is a meaningless panorama of unrelated or foreign impressions.

So it is natural that the laws of cause and effect, so noticed by those dwelling in more placid rural areas is lost on him. Add to that the fact that the average Urbanite is possessed of a hopelessly low I.Q. and the more intelligent is desperately neurotic and you have an urban populace of nitwits.

It's little wonder that the relatively normal Urbanite can't see the forest for the trees. Surrounded by the imbecilic and the twisted, he thinks he's anti-social, out of place and just a frustrated malcontent if he doesn't see his Disneyland for dummies as the best of all possible worlds.

If you corner him and give him the facts he'll admit he's uneasy for himself and his loved ones. But his job is there and besides, Congress won't let Social Security go bankrupt. The Russians aren't suicidal enough to start a nuclear war.

Without realizing it, he's been caught up in the hysteria of the dimwitted and the psychotic Urbanites around him. The wishful thinking of his inferiors has weakened his instincts for self preservation. Living in the timelessness of the parasite, he has no sense of history or of the laws of cause and effect.

Of course, Rurals have little better sense of history, as such. Since they are into a more basic economy they seldom need the education or the broad frame of reference requiring long term historical evaluations. But they are much more aware of the laws of cause and effect and so can better understand what happens when losers reproduce.

So the above and the following will be lost on Urbanites but will be understoody by most Rurals. But after all, the Urbanites are deservedly doomed and the Rurals are the seeds of the next civilization. So it's to the Rurals these warnings are redirected in hopes that humans will finally learn.

Warnings of overpopulation have been given since Plato's time and probably before. The warnings were all valid, as Greece, Rome and every following civilization was eventually swamped by vast numbers of useless and degenerate citizens. Misery and cultural loss has always been the price of "humans" breeding like animals.

Thomas Malthus put his finger on the problem in 1797 but was opposed by the Urbanites of his day. The following is from Chamber's Encyclopedia, 1891:

MALTHUS, THOMAS ROBERT, the expounder of the theory of population, was born 14th February 1766, at the Rookery, near Dorking, in Surrey, where his father owned a small estate. He was ninth wrangler at Cambridge in 1797, was elected Fellow of his college (Jesus), took orders, and was appointed to a parish in his native county. In 1798 he brought out his **Essay on the Principle of Population,** which attracted great attention and met with no little criticism. During the following years Malthus extended his knowledge of the subject both by travel and by reading, and in 1803 published a greatly enlarged edition of his essay. In 1805 he married happily, and soon after was appointed professor of Political Economy and Modern History in the East India Company's college at Haileybury, a post which he occupied till his death at Bath on 29th December 1834.

Personally Malthus was a kindly and accomplished man, who followed what he believed to be the truth, and who endured without a complaint the abuse and misunderstanding to which his writings exposed him. The aim of the **Essay** was to supply a reasoned corrective to the theories regarding the perfectibility of society, which had been diffused by Rousseau and his school, and which had been advocated in England by Godwin. Malthus maintained that such optimistic hopes are rendered baseless by the natural tendency of population to increase faster than the means of subsistence. He pointed out that both in the animal and vegetable kingdoms life was so prolific that if allowed free room to multiply it would fill millions of worlds in the course of a few thousand years. The only limit to its increase is the want of room and food. With regard to man, the question is complicated by the fact that the instinct of propagation is controlled by reason; but even in his case the ultimate check

ounces of water. Of this solution twenty to sixty drops are to be poured into a tumblerful of water, and a table-spoonful is to be snuffed up the nostrils every two hours; and if there be any soreness in the throat the same liquid is to be used as a gargle. It will, perhaps, be better to apply this solution by means of the fountain syringe, or some other of the methods adopted for injecting salt and water, as a cure for catarrh.

CURE OF CHRONIC SOMNAMBULISM.

A foreign medical journal mentions two instances in which chronic somnambulism was cured by administering bromide of potassium, the dose given in one instance varying from thirty to one hundred grains per day; and in the other case fifteen grains were given both morning and evening. The attacks in each case gradually became less and less frequent, and in a short time entirely ceased.

REPORT OF THE SUTRO TUNNEL COMMISSION.

The report of the Sutro Tunnel Commission is printed in detail, as an appendix to the report of the Chief Engineer of the army, just issued. The commission consisted of General H. G. Wright, General J. G. Foster, and Mr. Wesley Newcomb, civil engineer, who gave the subject a thorough examination. The conclusions to which they came are that the tunnel is not a necessity for drainage, but that, in some cases, it promises increased economy in working mines, and in rendering available the now worthless ores in the Comstock lode, thus becoming of national importance. The feasibility of the tunnel, the commission think, is placed beyond a doubt, its cost being estimated at four and a half millions in gold, the work to be done in three and a half years; and this period may be considerably reduced if proper machinery be employed.

The value of the bullion heretofore extracted from the mines of the Comstock lode is estimated at $125,000,000, while the present annual yield is about $15,000,000. The commission believe that the lode is a true fissure vein; but whether it will continue to be ore-bearing can not be predicted with certainty. In deep mining the commission regard the experiment of the tunnel as of great importance.

SIMPLE CONSTRUCTION OF CONCAVE AND CONVEX MIRRORS.

The German journals speak with approval of the invention of Nesmith, of Manchester, for the ready preparation of concave and convex mirrors, which usually constitutes an expensive and tedious branch of the glass manufacturer's art. For this purpose a flat plate of glass, about forty inches in diameter and three-sixteenths of an inch thick, is first cemented to an iron mould, hollowed out hemispherically. By means of a tube attached to this mould all the air can be removed from the hollow space beneath the glass. The simple act of sucking away the air by means of the mouth will cause the disk to bend under the pressure of the external air, so as to acquire a concavity in the middle of three-fourths of an inch. If air be blown into the cavity, on the other hand, the plate becomes convex. It is expected that the process can be made so perfect as to render the convexity uniform for two plates, which, when cemented around by their edges, and filled with some strongly refracting liquid, will serve the purpose of a cheap and powerful lens. Indeed, an inventor in Baltimore has realized this expectation, and succeeded in producing lenses of great power and unusual cheapness.

to population is the want of food, only it seldom operates directly, but takes a variety of forms in accordance with the complexity of human society. The more immediate checks are either preventive or positive. The former appear as moral restraint or vice. The positive checks are exceedingly various, including all unwholesome occupations, severe labour and exposure to the seasons, extreme poverty, bad nursing of children, large towns, excesses of all kinds, the whole train of common diseases and epidemics, wars, plague, and famine. Malthus goes on to illustrate the action of his principle by a review of the history of the different nations and races, showing what are the actual checks that have limited population — celibacy, wars, infanticide, plagues, vicious practices — and proving that the population difficulty has affected the development of society from the beginning.

It cannot be said that Malthus was original in his exposition of the theory of population. It is a theme of both Plato and Aristotle. Shortly before the time of Malthus the problem had been handled by Benjamin Franklin, Hume, and many other writers. Malthus crystallised the views of those writers, and presented them in systematic form with elaborate proofs derived from history. In certain details and in the form of exposition the **Essay** may be criticised; but the broad principles of it can be doubted only by those who do not understand the question. The enormous increase of the means of subsistence attained by colonisation and modern industrial development has only for a time postponed the population difficulty for the world at large, while its pressure is still felt in the more thickly people centres both of Europe and of the East. At the present time the most interesting feature of Malthus is his relation to Darwin. Darwin said on reading Malthus **On Population** that natural selection was the inevitable result of the rapid increase of all organic beings' for such rapid increase necessarily leads to the struggle for existence. To prevent misunderstanding it should be added that Malthus gives no sanction to the theories and practices currently known as Malthusianism. In this reference Malthus approved only of the principle of moral self-restraint; 'do not marry till you have a fair prospect of supporting a family.

Margaret Sanger published ''Woman And The New Race'' in 1920. She was a nurse working among the Urban poor and campaigning for freedom to publish information on birth control. The degenerate Moral Majority of her day charged her with being a pornographer and held up birth control until it was too late. By the time birth control information was legalized, welfare took away most of the misery of excessive childbearing and even encouraged it.

Margaret Sanger was also accused of being a Socialist, since she addressed herself to the working poor. This was nonsense, since the Socialists rejected her program. Birth control would have relieved the misery the Socialists depended on to put them in power.

Following are some excerpts from ''Woman And The New Race'', 1920:

WOMAN AND THE NEW RACE 1920

Page 4 By Margaret Sanger

''The creators of over-population are the women, who, while wringing their hands over each fresh horror, submit anew to their task of producing the multitudes who will bring about the **next** tragedy of civilization.

''While unknowingly laying the foundations of tyrannies and providing the human tinder for racial conflagrations, woman was also unknowingly creating slums, filling asylums with insane, and institutions with other defectives. She was replenishing the ranks of the prostitutes, furnishing grist for the criminal courts and inmates for prisons. Had she planned deliberately to achieve this tragic total of human waste and misery, she could hardly have done it more effectively.

Page 7

''War, famine, poverty and oppression of the workers will continue while woman makes life cheap. They will cease only when she limits her reproductivity and human life is no longer a thing to be wasted.

Page 138

''Labor seems instinctively to have recognized the fact that its servitude springs from numbers. The basic principle of craft unionism is limitation of the number of workers in a given trade. Every unionist knows that if that number is kept small enough, his organization can compel increases of wages, steady employment and decent working conditions.

''The weakness of craft unionism is that it applies its policy of limitation of numbers only

IMPROVED MODE OF NICKEL PLATING.

Mr. Keith announces an improved method of nickel plating, by which he obtains a flexible and tenacious deposit, the ordinary coatings of this metal being so brittle that the articles will not admit of the least bending. The invention consists in adding to the various solutions of nickel, whether formed of single or double salts, materials which, by their presence, prevent the decomposition of the solution of the plating bath, and the deposition of oxide of nickel and other impurities upon the articles receiving the coating of nickel. There is added to the solution of nickel one or more salts, either single or double, acid or neutral, or associate, formed by the union of organic acids, acetic, citric, and tartaric, with the alkalies and alkaline earths, ammonia, soda, potash, magnesia, or alumina. These additions will, it is asserted, counteract the tendency to decomposition of the solution by action of the electric current. These various organic acid salts may be added interchangeably and collectively, though the inventor prefers to use, in case of the double salts of nickel and alkalies and alkaline earths, the organic acid salts which have for their bases the alkali or alkaline earth which is associated with the nickel in its double salt. Thus when using a solution of nickel and ammonia, an organic acid salt of ammonia is preferred, though the similar salts of soda and potash will answer very well. In case of using a solution of a double salt of nickel and potash, or a double salt of nickel and soda, an organic acid salt of soda and potash is selected. Of the salts which can be used to accomplish the effect the tartrates are preferable. A comparatively small quantity of the organic salts is necessary to be added,

GILDING AND SILVERING SILK.

According to a formula published by Grüne, for silvering or gilding silk, the silk is to be soaked with a 5 per cent. solution of iodide of potassium, and dried; then (in non-actinic light) dipped in a 5 per cent. solution of nitrate of silver, containing a few drops of nitric acid, and well drained; next exposed for a few minutes to sunlight, and then dipped in a 2 per cent. solution of sulphate of iron. It immediately becomes gray, from reduction of metallic silver, and, after washing and drying, only requires burnishing in order to acquire the metallic lustre. By repeating this treatment, varied, however, by adding a little free iodine to the solution of iodide of potassium, the silver deposit becomes stronger. By laying the silvered silk in a very weak solution of chloride of gold, the silver becomes chloride, and gold is deposited; and by then removing the chloride of silver by a solution of hyposulphite of soda, washing, drying, and burnishing, the appearance of gilding is produced, if the deposit of metal be sufficiently thick. The purest chemicals must be used in order to secure satisfactory results.

HYGRAFFINITY.

In a very important paper on the "Estimation of Antimony," published in the *Chemical News*, Hugo Tamm calls the attention of chemists to a new phenomenon, which the author describes under the name of "hygraffinity." This phenomenon was discovered in a peculiar compound of antimony—bigallate of antimony—which is totally insoluble in water, and yet possesses a powerful affinity for moisture, which it absorbs rapidly from the air, after being dried at the temperature of 212° F. Most powders and precipitates, dried at that temperature, as is well known, absorb moisture on exposure to the atmosphere, but this is a purely physical phenomenon, due to porosity. On the contrary, in the case of gallate of antimony, chemical af-

to the trade. In his home, the worker, whether he is a unionist or non-unionist, goes on producing large numbers of children to compete with him eventually in the labor market."

The last is an excerpt from Lothrup Stoddard's, "The Revolt Against Civilization", 1922. It is reprinted in full in U.S. MILITIA.

THE REVOLT AGAINST CIVILIZATION 1922

By Lothrop Stoddard

U.S. MILITIA

"In the last analysis, civilization always depends upon the qualities of the people who are the bearers of it. All the vast accumulations of instruments and ideas, massed and welded into marvelous structures rising harmoniously in glittering majesty, rest upon living foundations — upon the men and women who create and sustain them. So long as those men and women are able to support it, the structure rises, broad-based and serene; but let the living foundations prove unequal to their task, and the mightiest civilization sags, cracks, and at last crashes down into chaotic ruin."

Stoddard was the first, to my knowledge, to illustrate the reality of the "Underman". The Underman, or sub-human, is a concept totally rejected by Urbanites, most of whom are sub-human.

You see, all humans are of the genus, homo, or man, but not all men are human. Humanity denotes a level of conciousness and awdreness enabling one to successfully integrate into ones social structure. Lacking such consciousness and awareness puts the blighted Underman more on the level of one of the lower animals. He is either an enemy of humans and therefore predatory, or docile and unthinking, like a draft animal.

Whether blighted by heredity or afflicted with Minimal Brain Damage (see Vol. 1, pages 57 and 69), the Underman is a danger to society through predation, excess fecundity and parasitism. Non-violent Undermen must be sterilized, as their issue is unneeded and their care of the young is destructive of human characteristics. Violent Undermen must be destroyed.

Although the above is harsh, as the arch Underman, Nikita Kruschev said, "You can't make an omelet without breaking eggs". After the collapse brought on by the world's Undermen, Survivalists will have to temporarily set humanitarian principles aside in order to save what's left of humanity.

finity is at work, and this precipitate, after exposure to the air for two or three hours, actually absorbs two equivalents of water. In a word, this insoluble substance has as much affinity for moisture as deliquescent salts. But one of the most curious features in connection with this extraordinary phenomenon is that, on being dried at 212° F., bigallate of antimony loses the two equivalents of water which it had absorbed from the air, and that on being left exposed once more to the atmosphere it reabsorbs the same amount of moisture. This interesting experiment may be repeated indefinitely.

REDUCTION OF ORES BY CHLORIDE OF IRON.

A method of reducing ores by means of chloride of iron has recently been patented, which is specially adapted to the extraction of metals alloyed with sulphur, arsenic, or antimony. The process depends upon the fact that chloride of iron, in the presence of air and water, readily decomposes sulphur, arsenic, and antimonial combinations, iron or copper pyrites, the sulphurets of cobalt, nickel, sulphuret of antimony, lead, silver, etc. The chloride of iron is reduced to chloruret of iron, and the metals transferred into chlorides, the chloruret of iron being again changed to chloride by the influence of the oxygen of the atmosphere, etc. If among the ores to be manipulated there be too little sulphur, it is well to add, from time to time, a little free acid, such as nitric, in order to assist the reconstitution of the chloride of iron. With iron or copper pyrites it is only necessary to add common salt, since the sulphur of the ore is oxydized by means of the chloride of iron and atmospheric air, with the result of producing sulphate of iron or sulphate of copper.

HALFORD METHOD OF CURING SNAKE BITES.

A GREAT contrariety of opinion seems to exist in regard to the value of Dr. Halford's method of treating snake bites. The American and European physiologists who have discussed the question, or who have repeated the experiments, appear to attach very little value to it; but the Australian faculty are quite unanimous in their indorsement.

Professor Halford, in a recent communication, discusses the symptoms of twenty cases treated by his process, under the hands of different practitioners, widely remote from each other. In seventeen cases recovery followed; and in thirteen of these the practitioners were of the opinion that death would certainly have ensued without this counteracting agency. The treatment consists in injecting about three minims of dilute ammonia, of the specific gravity of .959, into a superficial vein, by piercing its coats with the nozzle of a hypodermic syringe. The curative effect is said to be almost immediate, and several physicians stated that the recovery from collapse was so rapid and startling as to be almost magical. It still remains a question, however, whether, notwithstanding Dr. Halford's assurances, the Australian snakes are really as venomous as those of America—the contrary being, it is understood, the opinion of Dr. Krefft, of Sydney. We await with much interest the result of renewed experiments in this country,

Constructing a Light, Adjustable DRAFTING TABLE for Home Workshop Use

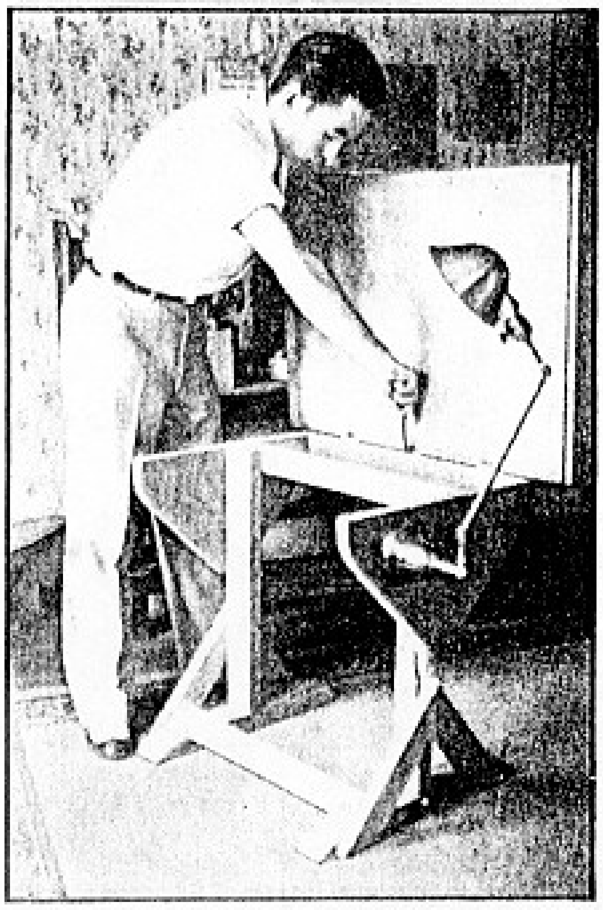
POPULAR SCIENCE MONTHLY
December, 1933

Light as it is, this drafting table is strong, rigid, easily adjusted, and well illuminated

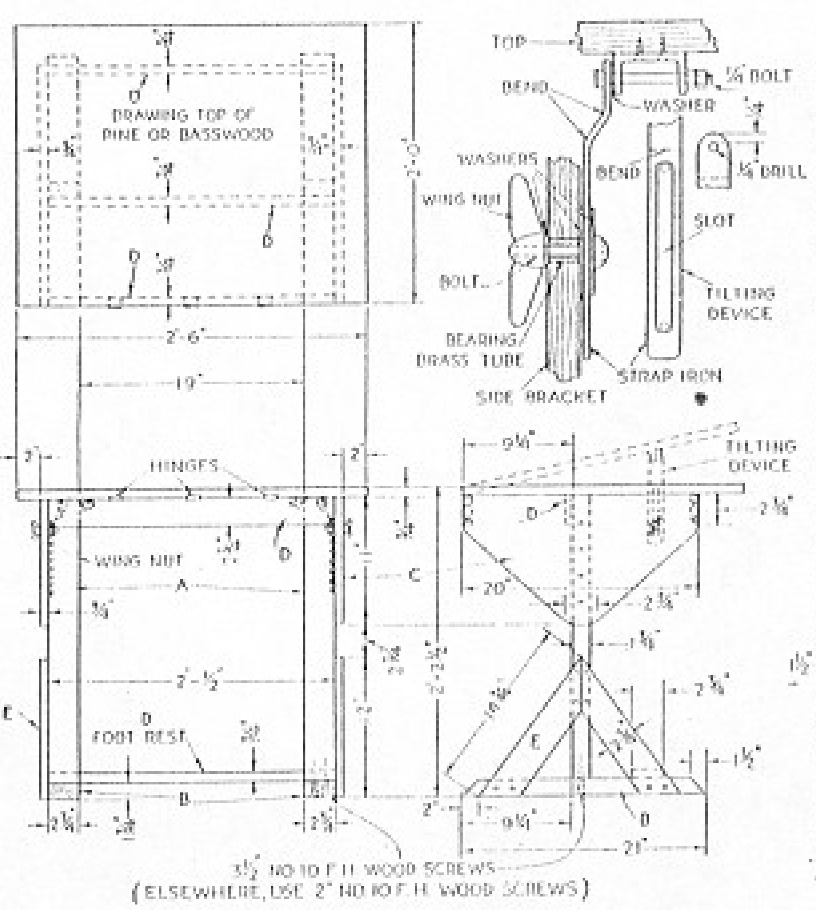
By Leslie M. Holbrook

A HANDY all-purpose drafting table is a necessary part of the home craftsman's equipment. The table described here, although extremely light, is rigid and strong and requires a minimum of space.

For the top you may use an ordinary drawing board of pine or basswood, or make one from sugar pine as shown. The stand is also constructed of sugar pine. To assemble the end frames, fasten foot *B* to the leg *A* with 3½-in. No. 10 wood screws and glue. Then select two of the diagonal braces *E* and fasten them as shown in the side elevation. Side bracket *C* should be cut as suggested in the same view unless you desire to mount a cabinet on the stand for supplies; in that case the ends may be left straight. Fasten *C* to leg *A* with glue and four wood screws. Then assemble all with crosspieces *D* and add the foot rest where most comfortable.

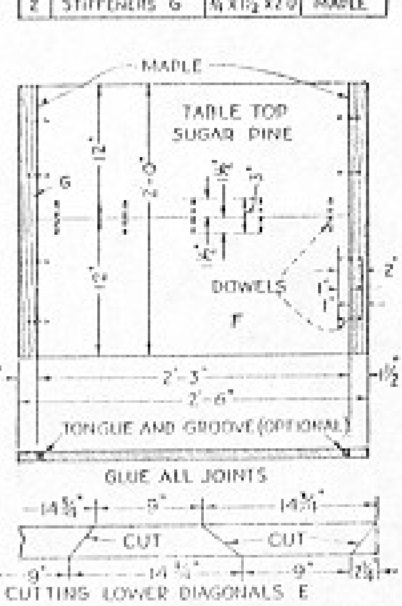


The top is attached to the framework with three brass hinges. Note the lamp bracket



LIST OF MATERIALS

NO	PART	T. W. L.	MATERIAL
2	LEGS A	1¾" x 2¾" x 2'0"	SUGAR PINE
2	FEET B	1¾" x 2¾" x 21"	" "
2	SIDE BRACKETS C	¾" x 11" x 23"	" "
4	CROSSPIECES AND FOOT REST D	¾" x 2¾" x 2'6"	" "
4	DIAGONAL BRACES E	¾" x 2¾" x 14¾"	" "
2	DRAWING SURFACE F	¾" x 12" x 2'3"	" "
2	STIFFENERS G	¾" x 1½" x 2'0"	MAPLE



Top, front, and end views, and details of the top, the braces *E*, and the tilting device

and can only express the hope that the application may be successful in cases of bites of rattlesnakes and copper-heads; since in the latest memoir on the venom of the rattlesnake, by Dr. Mitchell, of Philadelphia, he expresses the opinion positively that no remedy exists in cases where the poison is mature, and has been fairly introduced into the circulation in sufficient quantity.

MALLEABLE BRONZE.

It is said that in consequence of the announcements made some months ago before the Academy of Sciences of Paris in reference to the subject of malleable bronze, this substance is now likely to come into practical use in European and American art. The existence of such a substance has long been known from specimens of very ancient origin, and from its use by the Chinese in the construction of their tom-toms. It may be prepared from bell-metal bronze, to which 20 per cent. of tin has been added, and heating to a dark red. This generally brittle metal thus becomes malleable, and can be readily forged and rolled out from a thickness of three or four millimeters to that of a half to a quarter of a millimeter. In the operation the density of the metal is increased, and it can be welded easily, preserving its entire homogeneity. The whole secret rests in giving the bronze the proper degree of heat, since, without this, it remains brittle.

VARIATION IN THE SIZE OF BLOOD CORPUSCLES.

Dr. Manassein, of St. Petersburg, has ascertained that every influence which occasions a great alteration in any of the functions of the body alters materially the character of the red corpuscles of the blood. Among other points he ascertained that all circumstances tending to increase the temperature of the body reduced the size of the corpuscles, such as septicæmia, or poisoning an animal by the injection of putrid matter into its vessels, exposure of the body to a high temperature, and keeping the animal in a room surcharged with carbonic acid. On the other hand, the breathing of oxygen, exposure of the whole body to cold, the administration of hydrochlorate of quinine, cyanic acid, and alcohol tend to lower the temperature of the body, producing at the same time an enlargement or expansion of the corpuscles. Muriate of morphia constituted an exception; for, though producing depression of temperature, it also causes diminution of the size of the corpuscles, which is probably explicable on the supposition that it exerts an inhibitory influence on the respiratory acts, and therefore leads to the accumulation of carbonic acid in the blood. Acute anæmia also was found to cause dilatation of the corpuscles.

Continued on page 1896

FOR HOME CHEMISTS

Fun with Explosive Gases

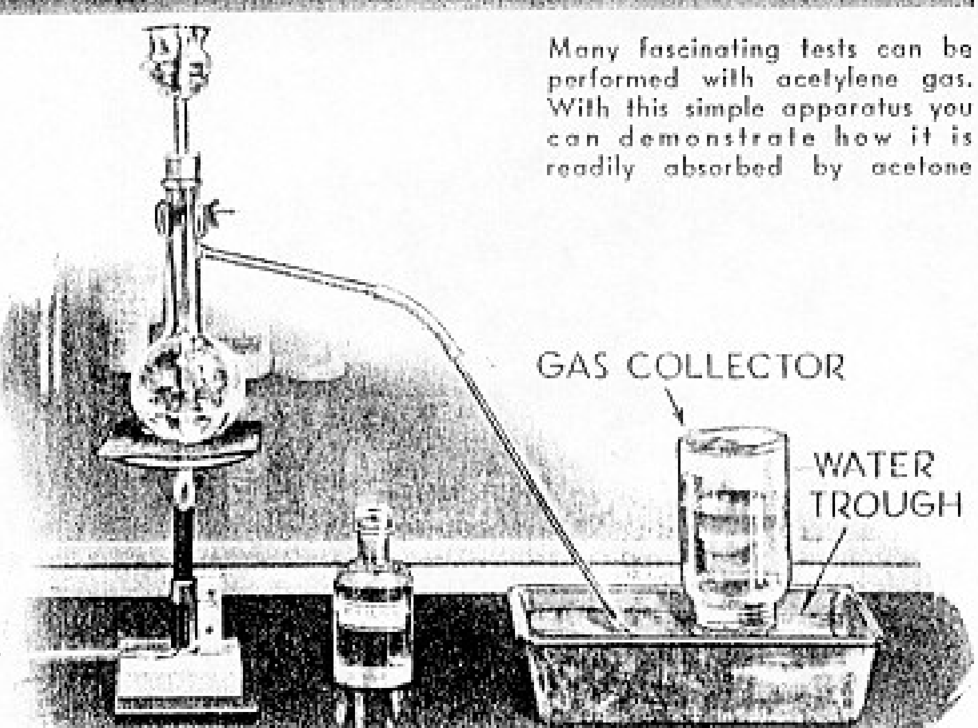
Hydrocarbons Are a Subject for Many Spectacular Experiments in the Amateur's Chemical Laboratory

By RAYMOND B. WAILES

POPULAR SCIENCE MONTHLY NOVEMBER, 1937

Tiny explosions and spectacular light flashes result from the reaction of chlorine gas with acetylene in the experiment above

Many fascinating tests can be performed with acetylene gas. With this simple apparatus you can demonstrate how it is readily absorbed by acetone



Heating alcohol and sulphuric acid together produces ethylene gas, which can be collected easily in inverted, water-filled bottles

WOULD you like to get gas from coal without heating the coal? To make an inflammable gas that will dissolve in certain liquids as easily as sugar does in coffee? To produce a gas that burns with a flame you can hardly perceive? Or to create fiery bubbles of gas, jumping about like grasshoppers, from simple everyday chemicals? These are some of the curious and interesting experiments with hydrocarbon gases that any amateur chemist can easily perform.

Hydrocarbon gases are compounds of carbon and hydrogen. A large proportion of all natural gases, including methane, ethane, propane, and butane, belong to this group. Manufactured illuminating gas—both coal gas and water gas—contains hydrocarbon gases, together with non-hydrocarbons such as hydrogen, carbon monoxide, carbon dioxide, and nitrogen.

Everyone knows that heating coal in a closed chamber or retort produces inflammable coal gas. Less familiar is the fact that coal slowly gives off hydrocarbon gases even without being heated. Miners know this, for they often hear the gas escaping with a hissing noise from fissures in underground seams of coal. They call it fire damp and must guard against it, for it forms a dangerously explosive mixture with air. Chemically speaking, fire damp is largely methane.

You can easily collect the same gas from ordinary house-furnace coal. A few days before you want to observe the result, pound up several large double handfuls of hard or soft coal into fragments the size of peas, or finer, and place the pulverized coal in a deep bowl of water. Connect the stem of a glass funnel to the glass part of a medicine dropper with a four-inch length of rubber tubing, and place the funnel, mouth down, over the coal. Suck the water up until it fills the funnel, and close the rubber tubing with a pinch clamp or a spring-type clothespin. Then let the set-up stand. From day to day, you will observe bubbles of gas rising from the coal, particularly when you tap the bowl, and they will be trapped under the glass bell of the funnel. In several days you should have a cupful of methane gas. Then, if the water level outside the funnel is higher than within, the gas will escape from the tip of the medicine dropper

when you open the pinch clamp. You can light it, and it will burn with a pale blue flame.

Gas that bubbles up through the water of marshes also is methane. You can collect it by stirring up the muddy bottom of a lily pool, or the ooze at the bottom of a marsh, and trapping the ascending bubbles under an inverted funnel. The marsh gas, too, will burn.

Methane can be manufactured in your home laboratory from sodium acetate. Place an ounce or two of the crystals on the lid of a tin can, or in a porcelain evaporating dish, and heat the material slowly. Soon it will become liquid. Continue heating for at least ten minutes more, to dehydrate or dry the sodium acetate. When it cools, if the heating has been sufficient, it will no longer be crystalline but will resemble powdery snow.

To the dehydrated sodium acetate, add about one tenth of its volume of sodium hydroxide (ordinary household lye will do) and an equal amount of unslaked lime (calcium oxide). Mix the ingredients thoroughly. Now place the mixture in a test tube, or an ignition tube closed at one end. Stopper the tube with a one-hole cork in which you have fitted the glass portion of a medicine dropper.

Heat the tube slowly, and wave the burner flame along its entire length every ten seconds or so. This will keep its whole surface at a high temperature and prevents water vapor from condensing, running back, and cracking the hot glass. Soon the chemical mixture will melt and methane gas will be given off at the end of the miniature retort system. Light it with a match, and it will burn for five minutes or more. Sodium compounds from the chemicals in the tube, borne along as a spray by the gas, tinge the flame yellow.

Methane gas does not react readily with most other chemicals. In contrast, showy experiments can be performed with acetylene, another hydrocarbon gas. This is the gas that produces the fierce oxyacetylene flame used for cutting metals, when it is burned with oxygen in a special torch. Acetylene has also found service in rural-home lighting and in bicycle and miners' lamps.

To generate acetylene and study its properties, obtain a can of calcium carbide, commonly sold simply as "carbide." A bicycle shop or a sporting-goods store is your most likely source of supply. Several lumps of the chemical placed in a large jar or can of water will liberate a copious quantity of acetylene. A bottleful of the gas may then be collected for experiment by guiding the stream of bubbles through a funnel into the submerged mouth of an inverted bottle filled with water, the rising gas displacing the water. Before you lift out the bottle of acetylene, cover the mouth with a sheet of glass or close it with a cork, to retain the gas until you are ready to use it.

Hold a match to the mouth of a bottle filled with acetylene. The gas will burn with a brilliant yellow flame, depositing a large amount of soot or carbon. If you let air mix with the acetylene and then apply a match, the gas mixture will explode with a plop. The explosion is harmless, provided you take care to use a bottle with a wide mouth.

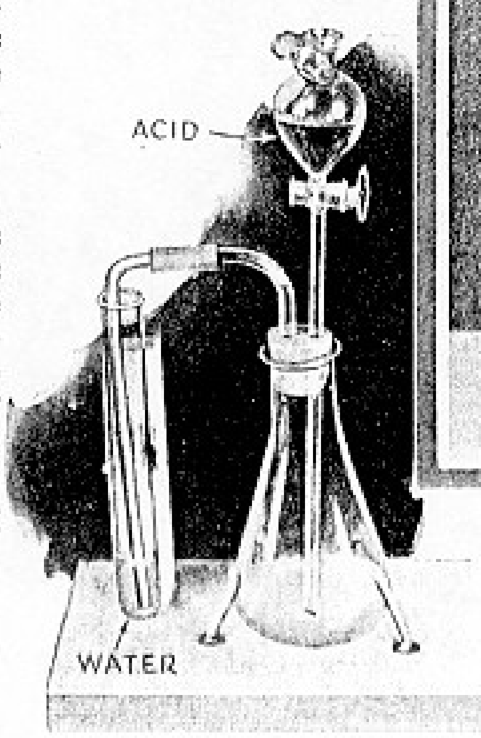
WHEN acetylene burns, it turns into carbon dioxide and water. These are the oxides of carbon and hydrogen, of which two atoms apiece make up the acetylene molecule. After you have burned a bottleful of acetylene gas, place several drops of clear limewater in the bottle and shake the liquid about. A white precipitate of calcium carbonate will turn the limewater milky, showing the presence of carbon dioxide, for which this is a test. The black flakes of soot in the bottle will not interfere. They float, due to the fact that they do not become wet with the liquid.

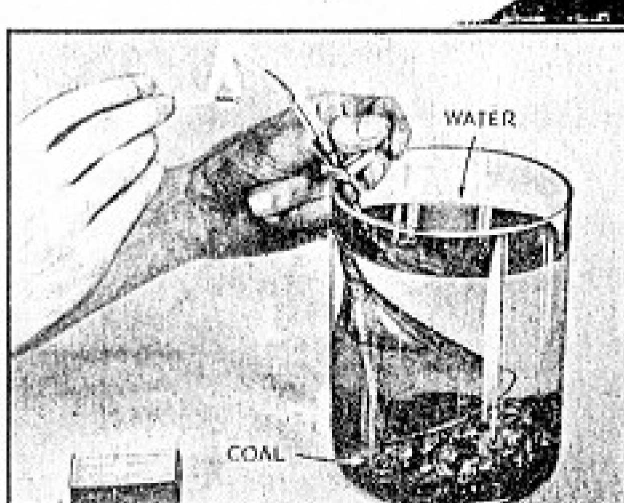
Acetylene will combine with a number of gases, and

NATURAL GAS
Marsh gas is the same, chemically, as the fire damp of mines, methane. It can be collected by stirring up the mud in a lily pond so the bubbles rise into an upside-down funnel

METHANE GAS is easily prepared by heating a mixture of sodium acetate, lye, and quicklime in a test tube as shown above. The gas flowing from the outlet burns readily

In the experiment below, acid dripping into the flask absorbs the ethylene gas it contains. A vacuum is formed, sucking water from the tube





FIRE DAMP, the cause of many mine explosions, issues from all coal. A quantity can be collected in an inverted funnel as shown in the illustration at the left

its reaction with chlorine is a spectacular one. To demonstrate this, place about a teaspoonful of ordinary bleaching powder (calcium hypochlorite) and about a fluid ounce (one eighth of an ordinary drinking glass) of water in a wide-mouthed bottle. Then add ten or twenty cubic centimeters (half a fluid ounce, more or less) of muriatic, or hydrochloric, acid. Chlorine gas is produced, and may be recognized by its yellowish color.

When the bottle has become filled with the gas, toss in a few lumps of calcium carbide. Falling into the water in the bottle, the carbide immediately gives off acetylene gas. As each bubble of acetylene bobs to the surface of the liquid, it comes in contact with the overlying chlorine gas, and the two gases react vigorously with each other. Each contact produces a flash of light, a tiny explosion, and a little cloud of soot. With the bombardment proceeding at the rate of several explosions a second, the bottle resembles a miniature battlefield.

Just as a lighted wax taper or a jet of burning hydrogen will continue to burn when it is lowered into a vessel filled with chlorine, so this fiery reaction between acetylene and chlorine provides another reminder of the curious fact that oxygen is not essential to produce a flame.

Confined under high pressure, acetylene may decompose and explode in response to heat or shock. Therefore cylinders of acetylene used for metal cutting are not filled merely by pumping in the compressed gas. Instead, they are first packed with asbestos fibers saturated in acetone, a liquid organic chemical that dissolves and thus stores up acetylene introduced under relatively low pressure.

WHAT makes this practical is the remarkable quantity of acetylene gas that acetone will absorb. You can observe the effect for yourself with the aid of an easily assembled bit of apparatus. Attach a four-inch length of rubber tubing to the top of a burette, or to one end of a glass tube two feet long and half an inch in diameter. Arrange two pinch clamps on the rubber tubing, one near each end. Stand the glass column vertically, with the rubber-tubing end upward and the lower end fitted to the stem of a funnel inverted in a bowl of water. Now suck upon the rubber tubing until the burette or glass tube is filled with water, and close the pinch clamps. Place several lumps of calcium carbide in the water under the funnel.

Acetylene gas will be instantly evolved, and the bubbles will rise in the water-filled column, growing smaller and smaller as they approach its top. The bubbles contain some water vapor that is condensing, and the acetylene itself is dissolving in water. Soon, however, the glass tube is filled with the gas. Now open the upper pinch clamp and fill the short section of rubber tubing with acetone. Close the upper pinch clamp, open the lower one, and squeeze the rubber tubing. This will force the acetone down into the acetylene-filled glass tube. As the liquid runs down the walls, it absorbs acetylene. A partial vacuum is created, and atmospheric pressure forces water up into the glass tube to take the place of the acetylene that has been dissolved. A single cubic centimeter of acetone will absorb about twenty-five cubic centimeters of acetylene gas. For comparison, you can repeat the experiment with other solvents that will dissolve acetylene, such as carbon tetrachloride and turpentine.

ETHYLENE, like methane and acetylene, offers interesting possibilities for home experiments. This gaseous hydrocarbon is used in ripening bananas artificially, and is present in illuminating gas. It can be prepared easily in an amateur laboratory.

To generate ethylene, place about thirty cubic centimeters (one fluid ounce) of grain alcohol or denatured radiator alcohol in a flask and add about twenty-five cubic centimeters of strong sulphuric acid. Heat the mixture, and the acid will dehydrate the alcohol or chemically abstract water from it, liberating ethylene gas.

If you use a flask of the distilling type, fit it with a single-hole cork carrying a thistle tube, through which the acid is added. Lead the gas that issues from the side arm, through rubber tubing, to a turned-up glass tube submerged in a pneumatic trough or gas-collecting basin filled with water. In case your flask has no side arm, fit it with a two-hole cork carrying the thistle tube and also a bent delivery tube of glass leading to the pneumatic trough. Water-filled bottles, inverted in the basin, will collect the gas and may be closed with glass plates until it is used. The gas will burn with a white, luminous flame. You can safely mix ethylene with air in a wide-mouthed bottle and explode it with a lighted match.

STRONG sulphuric acid absorbs ethylene, and you can show this in much the same fashion as you demonstrated how acetone absorbs acetylene—that is, by letting the action create a partial vacuum and draw up water. If you have assembled the handy little gas generator described in a previous article of this series (P.S.M., May '37, p. 68), it will prove especially suitable for this purpose. The device consists simply of a small flask with a two-hole stopper, which carries a separatory funnel and a gas delivery tube leading into an open test tube, the whole being mounted on a base for convenience.

Fill the flask with ethylene, letting the gas pass in through the delivery tube while the stopcock of the funnel is open. Then close the stopcock and arrange the delivery tube of the flask to dip in water placed in the test tube. Put some strong sulphuric acid in the separatory funnel, admit several cubic centimeters of it to the flask, and then close the stopcock again. The acid will absorb the gas, and the vacuum will draw water from the test tube into the flask. If you substitute ordinary illuminating gas for ethylene, you will also be able to observe its loss in volume, though it will be considerably less in this case, since illuminating gas contains only a small percentage of ethylene.

This may be a good point for a word of caution to overzealous home experimenters against the temptation to mix things together indiscriminately and see what will happen. Some hydrocarbons—acetylene, for example—form highly explosive compounds with certain chemicals. Likewise it is perfectly possible to prepare dangerous substances from other easily obtained laboratory materials. Plain common sense should warn any amateur chemist to stick to experiments that he positively knows to be safe, which of course include all of those specifically recommended in these articles.

Continued from page 1893

HARD WATER *VERSUS* SOFT.

The curious proposition has recently been enunciated by Dr. Letheby, of London, that moderately hard water is better suited for drinking than that which is soft. He states that a larger percentage of French conscripts are rejected from soft-water districts than from neighborhoods supplied with hard water; and also that English towns, with water of more than ten degrees of hardness, have a mortality of four per thousand less than those whose inhabitants use softer water. This assertion, so contrary to the usual theory in the matter, is, as might be expected, sharply contested by other sanitarians, and the final result of the controversy will be looked for with much interest by the general public.

STOLBA PROCESS OF TINNING.

We have already referred to the process of tinning in the cold devised by Professor Stolba, of Prague, and we now learn that his experiments have been repeated with much success. The tinning of cast iron, wrought iron, steel, copper, and brass is found to be very satisfactory, the tin adhering very firmly, even when in very thin layers. Diluted sulphuric acid, however, it is said, generally produced dark spots and removed the coating. Experiments have been made to apply the same process for the ornamentation of metallic objects. These were tried especially upon cast iron articles electroplated with copper, where the projecting edges were tinned, with excellent effect. As greasy spots can not be tinned, it is only necessary to apply very thin layers of oil to the places where no deposit is desired in order to coat the remainder of the article with tin, thus producing a striking contrast.

CHARACTERS OF PURE GLYCERINE.

According to Köller, among the characteristics of pure glycerine, as compared with an impure article, are the following. Pure glycerine has a neutral reaction, and on evaporation in a porcelain dish leaves only a very slight carbona-

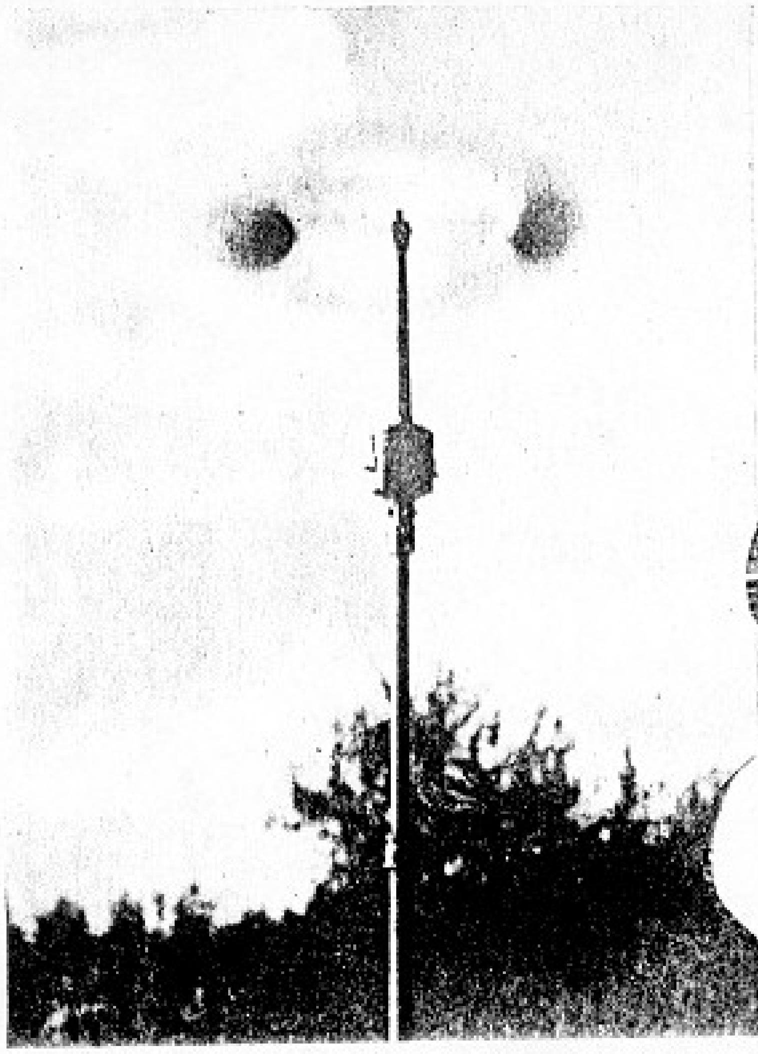
Continued on page 1898

HOMEMADE Electric Anemometer

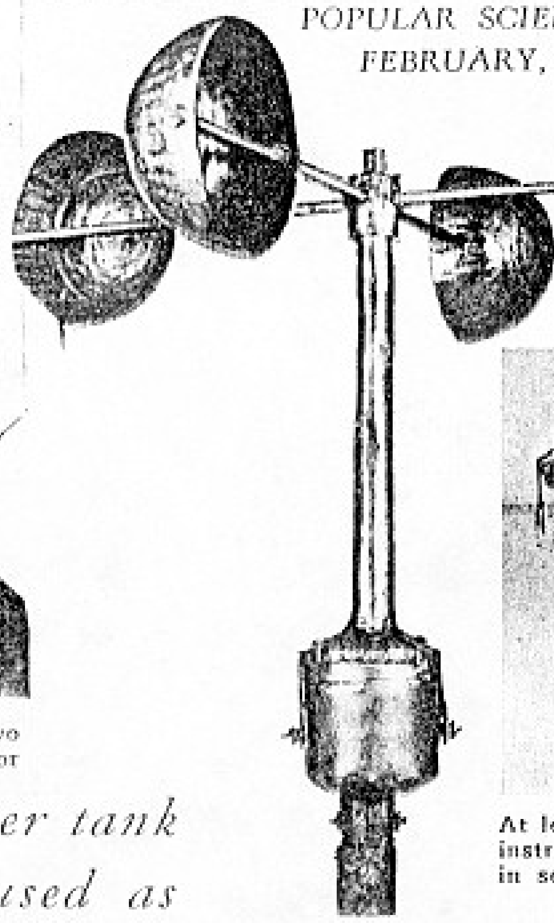
REGISTERS VELOCITY OF WIND

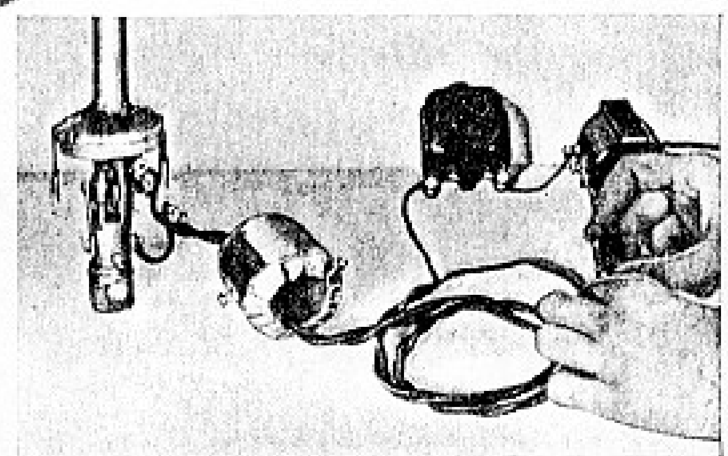
POPULAR SCIENCE MONTHLY
FEBRUARY, 1937

By Charles A. Laird



The finished anemometer mounted on a pipe support. Two wires run down and connect with an indoor indicator





At left is a close-up of the vanes, arms, and body of the instrument. Above is a view to show how it is connected in series with buzzer, doorbell transformer, and switch

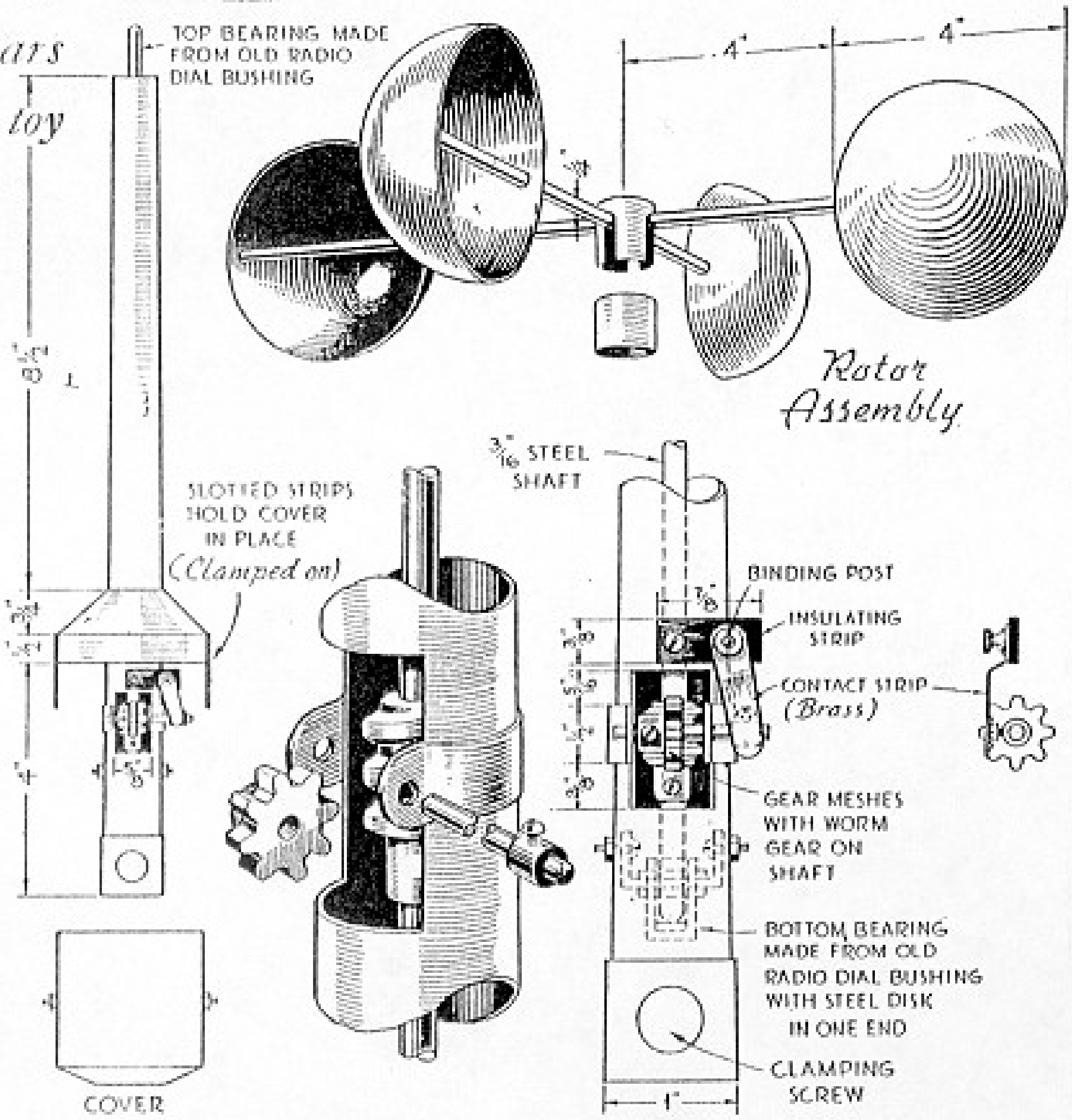
Cheap copper tank floats are used as vanes, and the gears are taken from a toy construction set

AT LARGE airports, U. S. Weather Bureau offices, and observatories, the anemometer or wind-velocity indicator with its spinning cups is always an attraction. The one to be described is capable of indicating wind velocity with accuracy, and it may be placed at any reasonable distance from the actual indicator, which is an ordinary electric buzzer.

The cups in this model were made from copper flush-tank bulbs or floats, which cost about twenty cents each. You will need two of them, and they should have a diameter of 4 in. (the standard 4 by 5-in. size). Take a sharp pair of shears and cut the halves of each bulb apart on the seam. Remove the threaded socket from the one half of each pair and solder a thin circle of copper over the hole.

The cross arms are made of 1/4-in. brass tubing 16 in. long, to which the cups are soldered. The rods are flattened in the center, and a 3/16-in. hole is drilled through both where they cross. This assembly is soldered to a 3/16-in. bushing, which will be used to clamp it on the upright shaft. A small cover should be soldered on to keep water out of the top bearing.

The body of the anemometer is made of galvanized iron or heavy sheet brass, or you can use a piece of brass tubing 1 in. in diameter and with walls about 1/16 in. thick. The top bearing is a simple bushing in which the shaft revolves. It may be made of Babbitt metal poured around the shaft or from a regular brass bushing in which the shaft should fit rather loosely. The type of bearing used

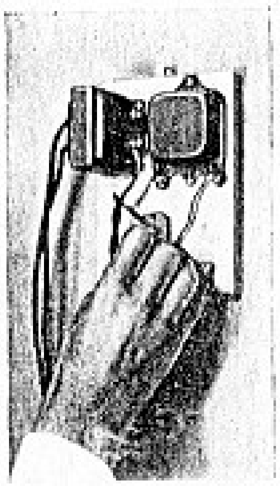


How rotor is assembled, gears and contact strip mounted, and the mechanism housed

at the bottom is called a step bearing and consists of the inside bushing of a radio dial with a hard steel plate at the bottom. The end of the shaft is convex and rests on the steel disk. This bearing, which must be well oiled, gives almost frictionless support to the sha.'.

The heart of the instrument is the gearing, and the gears must have a ratio of eight to one. A worm gear of the type found in toy mechanical sets is clamped to the upright shaft as shown. This gear has three threads to ½ in. It is about ⅞ in. in length and is threaded for ½ in. of its total length. A set screw is inserted in one end as shown. As the hole in this gear is only 5/32 in. in diameter, it must be reamed out to fit on the 3/16-in. shaft.

The worm gear meshes with a small gear wheel clamped on a short shaft and supported by two 1/16-in. brass ears, which are drilled to form two simple bearings. These are bolted or well soldered to the upright casing or body of the anemometer. The gear wheel itself has an outside diameter of ⅝ in. and has eight teeth.



Buzzer, transformer, and switch, as mounted

An anemometer with the cup sizes and arm lengths used in this one will revolve approximately 500 times with the passage of one mile of wind. In order to find the current wind velocity, it will be necessary to reduce the mile readings to 1/60 the total wind mileage; therefore our anemometer must close a contact every 8 turns instead of every 500, allowing 20 turns loss for friction. In this way it will be necessary only to find out how often the cups revolve 8 times in one minute, each 8 turns indicating 1/60 of a mile of wind.

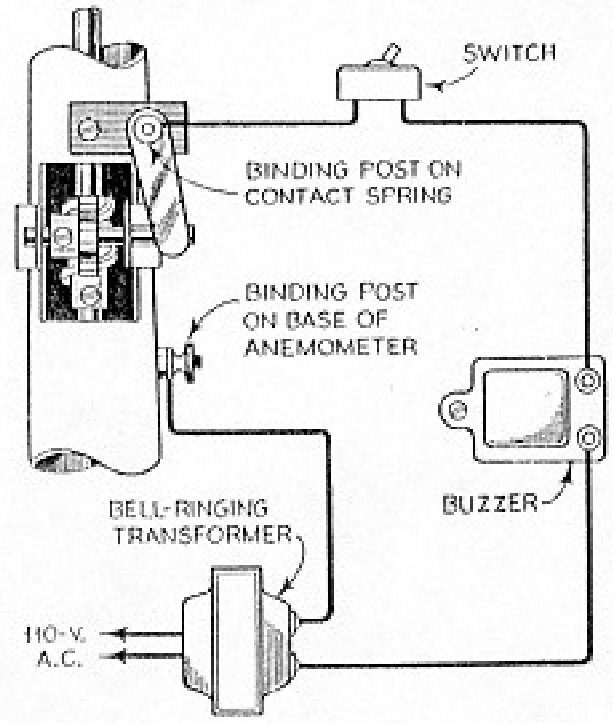
A small screw on the gear shaft closes the contact for every turn of the gear wheel by rubbing against a small strip of brass as shown. The contact and the gear are protected from the weather by a small cover made of thin galvanized sheet iron or brass.

The bottom of the anemometer is fitted with a set screw so that it may be mounted on a 1-in. pipe support.

A buzzer and transformer or dry cell should be connected with the anemometer as shown.

To find the wind velocity, it is necessary only to turn on the current with the switch. The number of buzzes in one minute indicates the wind velocity in miles per hour.

The finished instrument requires reasonable care, and the bearings should be oiled occasionally with clock oil. The whole mechanism should be cleaned twice a year in gasoline.



The wiring diagram. The number of buzzes a minute shows wind velocity in miles an hour

Continued from page 1896

ceous crust, while the impure has a much greater percentage of coaly matter. The pure article does not become brown when treated, drop by drop, with concentrated sulphuric acid, even after several hours; the impure becomes brown even when but slightly adulterated. Pure glycerine, treated with pure nitric acid and a solution of nitrate of silver, does not become cloudy, while the impure exhibits a decidedly milky appearance. Sometimes the impure article becomes blackened with the sulphide of ammonium. Oxalate of ammonia produces a black clouding; lime-water sometimes causes a milky discoloration. Pure glycerine, however, constantly remains perfectly uncolored, and clear as water, the impure becoming colored to a greater or less extent. If a few drops are rubbed between the fingers, pure glycerine causes no fatty smell; the contrary is the case with the impure, especially if a few drops of dilute sulphuric acid be introduced.

CROTON CHLORAL, A NEW HYPNOTIC.

Dr. Liebreich, of Berlin, to whom we owe the discovery of hydrate of chloral, has lately been investigating the physiological properties of a new organic compound formed by the action of chlorine upon allylene, and which he calls croton chloral. When administered to animals a peculiar effect is produced, the head being to a great extent rendered insensible to feeling, while the rest of the body remains comparatively sensible. If the inhalation is prolonged, the spinal cord loses its function, and reflex excitability is every where extinguished. During that stage both pulse and respiration remain unchanged. The third stage, which is induced by large doses, is characterized by paralysis of the medulla oblongata, and death. Animals may, however, be kept alive by artificial respiration, because the action of the heart is not interfered with, while the ultimate effect of hydrate of chloral is to paralyze the heart. Croton chloral, therefore, promises to produce all the good effects of hydrate of chloral, without any drawback being attached to its judicious use.

CŒRULEIN, A NEW COLORING MATTER.

A new coloring matter, named cœrulein, is announced by Baeyer as obtained from crystals of gallein, first produced from pyrogallic acid. If this substance be dissolved in sulphuric acid it furnishes an olive brown color, with aniline a rich indigo blue, and with alkalies a fine green. These colors are readily taken up by cloth, and are quite durable.

EFFECTS OF USING BROMIDE OF POTASSIUM.

Long-continued use of the bromide of potassium has, as is well known, a tendency to produce certain nervous diseases, which, according to Carles, present themselves under five different forms. The first is represented by acne; the second by ulcers of a dull yellow, having an offensive odor; third, red blotches, like purpura; fourth, by furuncles; fifth (the rarest of all), exhibits the appearance of eczema. Hitherto the only known method of causing the eruptions to disappear has been to suspend or diminish the employment of the bromide of potassium; but as there are cases where its continued use is necessary, it becomes important to discover some other way of meeting the difficulty.

From the observations of Dr. Carles, he is satisfied that the bromide of potassium is chiefly eliminated by the urine, and that it only establishes itself under the skin, producing the effects referred to when elimination by the kidneys is incomplete. On this account, therefore, he suggests the use of diuretics, and the opening of the pores of the skin by means of hot baths; and he found a very remarkable measure of success by this treatment.

NEW COLORING MATTERS.

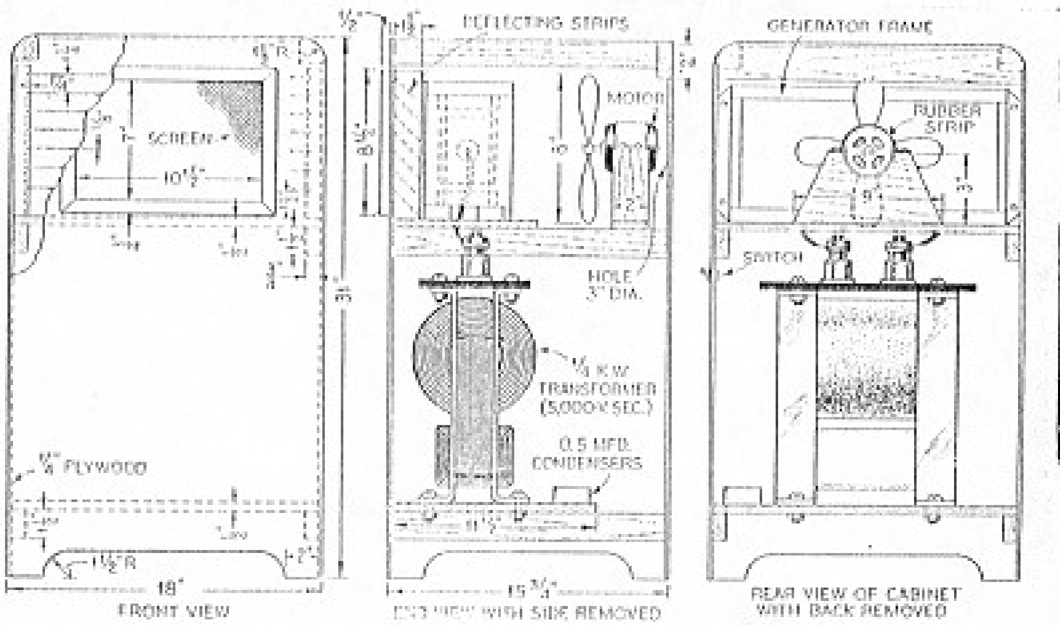
Professor Baeyer has lately brought to the notice of the Chemical Society of Berlin a new class of coloring matters. Thus, if pyrogallic acid be melted with naphthalic acid and some other substances, a new coloring material is ob-

Continued on page 1903

Electric Ozone Generator

PURIFIES AIR OF ROOM

POPULAR SCIENCE MONTHLY, JULY, 1937



The complete ozone generator fits into a comparatively small cabinet. There are three principal parts—high-voltage transformer, generating device, and small fan

By

E. A. RERUCHA

"HOW can I build an ozone generator for purifying the air of a room?" is a question readers sometimes ask.

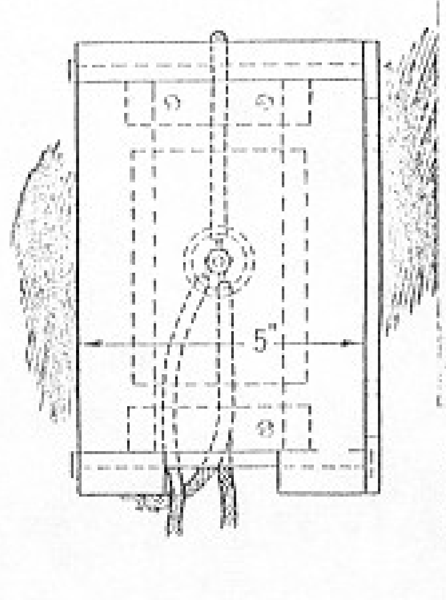
The most practical and economical method of producing ozone is by means of silent high-voltage discharges from the secondary of a high-voltage transformer. This is the method used commercially.

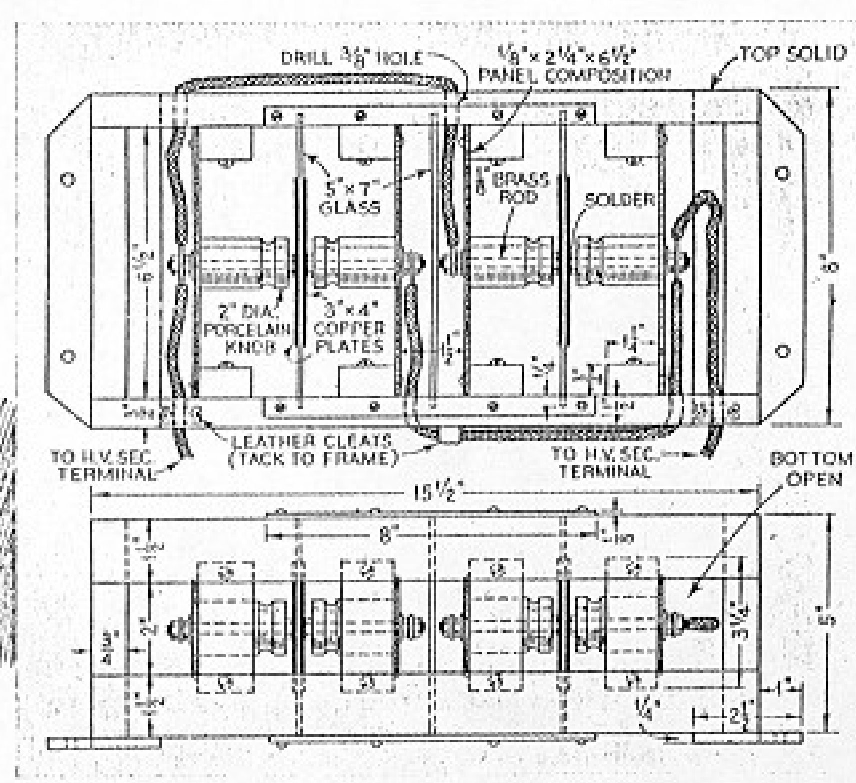
The Transformer. An ordinary high-voltage radio transmitting transformer of ¼-kilowatt producing a secondary voltage of 5,000 volts will be satisfactory. A new one costs about $25 from amateur radio supply houses, and secondhand ones are occasionally available from old "ham" radio experimenters. Neon sign transformers are excellent for the purpose. They may be obtained new for about $15, and there are plenty of them to be had secondhand. The one I used has a secondary voltage of 7,500, and in an experimental set-up it proved just as good as the other transformer.

A suggested arrangement is given in the drawings for an outfit using the ¼-k.w. transformer because this involves the more complicated problem. If a neon transformer is substituted, the condensers and ground need not be used. The secondary current is only 15 milliamperes, and the secondary is already grounded to the frame. The transformer is merely connected to the 110-volt line, and the secondary leads to the electrodes.

Ozone Generator. Copper electrode plates, insulators, and glass dielectric plates are mounted as shown at the right. The spacing is adjusted to suit the length of the insulators, the glass plate that serves as an insulating barrier between the two electrodes being placed in the center.

Each of the two generating units requires a good quality, thin glass plate 5 by 7 in., such as can be obtained by removing the emulsion from a glass photographic plate. On opposite sides of each plate are the 3 by 4-in. electrodes, of 28-gauge copper. These are soldered at the center to the ends of the threaded brass rods and also to the nuts. The cross supports, of hard panel composition, should be so placed that the copper plates are pressed firmly against the glass plates. The edges of the copper plates are stuck to the surface of the glass with cellulose tape, the copper being accurately centered on the





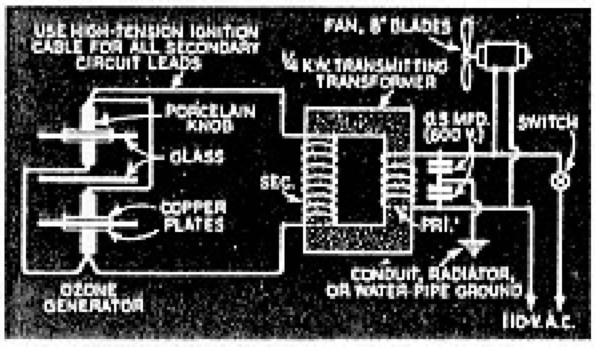
Front and top views of the generator and an end view drawn to a larger scale. There are two identical units in the generator, each consisting of two copper electrodes separated by a thin glass plate

glass.

High-tension, rubber-covered ignition cable is used to make the connections between plates and transformer terminals, a single length being used from one plate to the other and to the terminals. Use brass washers on each side of the cable and tighten the nuts securely so prevent disconnection of the cables and a possible serious short circuit. Support the cables with leather cleats. Keep each of them as far as possible from the opposite transformer terminal lead and electrode and from the low-voltage wires of the primary circuit. The primary circuit to the transformer, switch, and fan is wired with No. 14 house wire supported on porcelain cleats.

Assembly. Mount the parts in a suitable cabinet as shown in the general assembly drawings. The deflecting strips are 1/8 by 1½-in. plywood set in slots. Two turns of rubber from an old inner tube are wrapped around the motor before fastening the metal clamp. It pays to set the transformer on rubber cushions to eliminate as much of the hum as possible. The fan should be placed as far back as possible.

Wiring. The primary leads to the service outlet consist of about 20 ft. of No. 14 flexible lamp cord. To protect against any high-voltage surges, two 0.5-mfd. condensers are connected as in the wiring diagram. The junction between the two condensers is connected and soldered to both conductors of a piece of No. 14 lamp cord as long as required, and a radio ground clamp is used to connect both conductors with a radiator or water pipe. This is not required with a neon sign transformer.



How the apparatus is wired if a ¼-kilowatt radio transmitting transformer is utilized

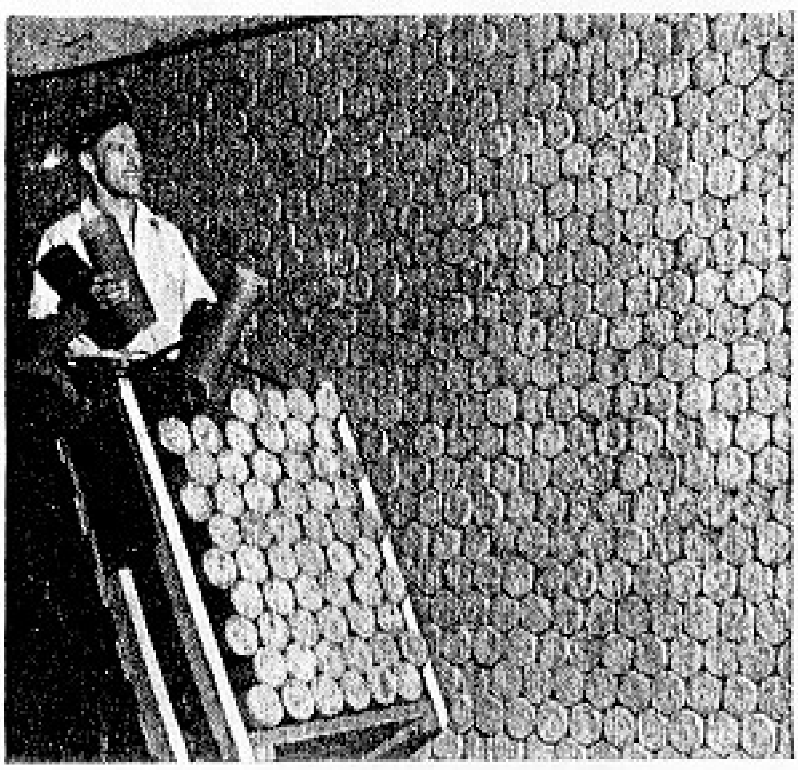
Operation. Attach the ground clamp before turning on the switch. The ozonized air will be diffused throughout the room by the fan and detected by its peculiar sweet odor. The device need not be in constant operation; it is merely turned on as required to keep the air fresh. The required proportion of ozone to air for sterilization purposes is very low; in fact it has been found that impure water containing as much as 1,000,000 bacteria per cubic centimeter will be completely sterilized when placed in contact with one cubic centimeter of air containing two grams of ozone per cubic meter, or 0.07 oz. of ozone in 1.2 cubic yards of air.

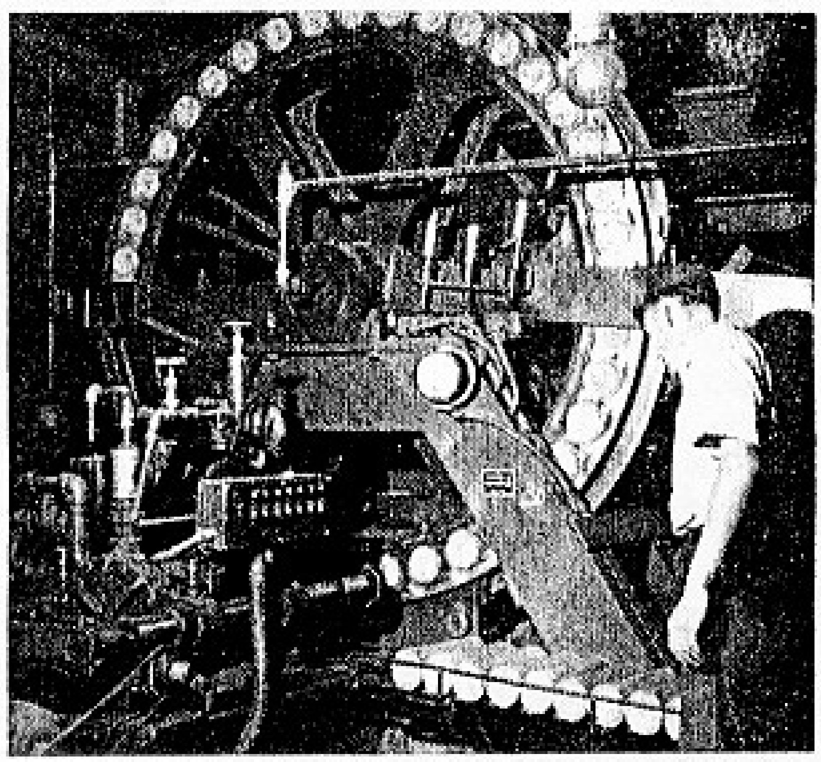
Precautions. Avoid jarring the apparatus, which might crack the glass plates. Caution small children against poking any object through the screen, as the high-voltage current will follow materials that may be almost perfect insulators for low voltages. Do not move the device while in operation, and do not stand directly in front of the screen and breathe the full strength of the ozonized air.

LIST OF MATERIALS

1 transformer as specified in text.
2—0.5-mfd. condensers, 600 volts.
3 pc. 5 by 7-in. glass from photographic plates.
4 porcelain knobs, 2 in. long.
4 copper plates, 3 by 4 in., 28-gauge.
4 pieces insulating panel composition (phenol-formaldehyde), 1/8 by 2¼ by 6½ in.
1 threaded brass rod, ¼-in. diameter, 12 in. long, 16 brass washers, and 12 hexagon brass nuts.
1 pc. bronze screen, 8 by 11½ in.
1 fan, 110 volts, 60-cycle, 8-in. blades.
1 radio ground clamp.
5 ft. rubber-insulated, high-tension ignition cable.
50 ft. No. 14 flexible lamp cord.
1 toggle snap switch, 3-ampere, 110 volts.
6 ft. No. 14 N.E.C. rubber-covered wire.
6 pairs of porcelain wire cleats.
1 sheet-metal clamp for motor mounting: rubber, cellulose tape, screws, etc.
Wood, plywood, finishes, etc., for constructing cabinet of any design desired.

Popular MechaNICS April 1952





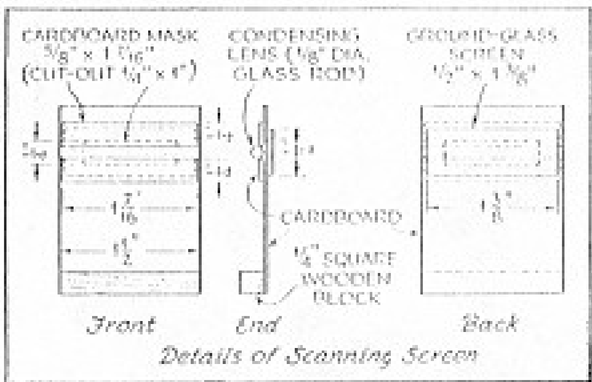
Sunflower Logs

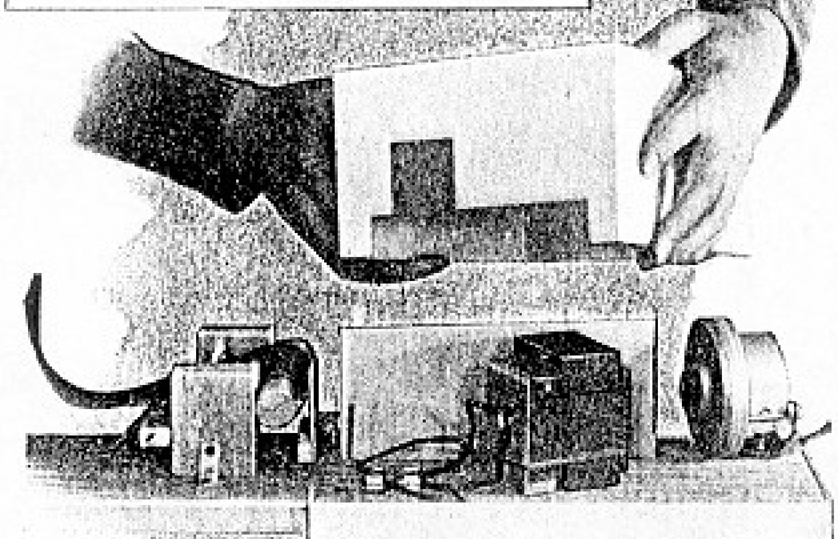
Ever burn a sunflower log? The logs, ideal as a fireplace fuel, roll from an Altona, Man., plant by the hundreds of thousands. For years the plant has extracted vegetable oil from sunflower seeds, but until recently the hulls were a liability. Now the hulls are fed into the sleeves of a circular briquetting machine. Under a pressure of 165,000 pounds per square inch, no binder is required to produce a log two to three times as dense as wood. Each log weighs 7¼ pounds and measures 12 inches long by 4 inches in diameter. It yields about the same heat as low-grade coal but leaves only one quarter the ash. Each pound of the fuel yields about 8100 B.T.U.s.

POPULAR SCIENCE MONTHLY

FEBRUARY, 1936

UNIQUE HOMEMADE Oscilloscope Shows Sound Waves *in* Action





ALTHOUGH you can build it at trifling cost, this remarkable instrument makes sound visible. It produces a fascinating motion picture of sound waves occurring as rapidly as 2,000 or more a second, and forms a graphic image of your voice, favorite radio program, or even the hum of an alternating-current power line. Those who do their own photographic developing can also record the image of the waves permanently on ordinary roll film.

The secret of the device is explained by the old bromide, "It's done with mirrors." The technical name for it, in fact, is a vibrating-mirror oscilloscope. Forbidding as this may sound, the principle of operation is really quite simple.

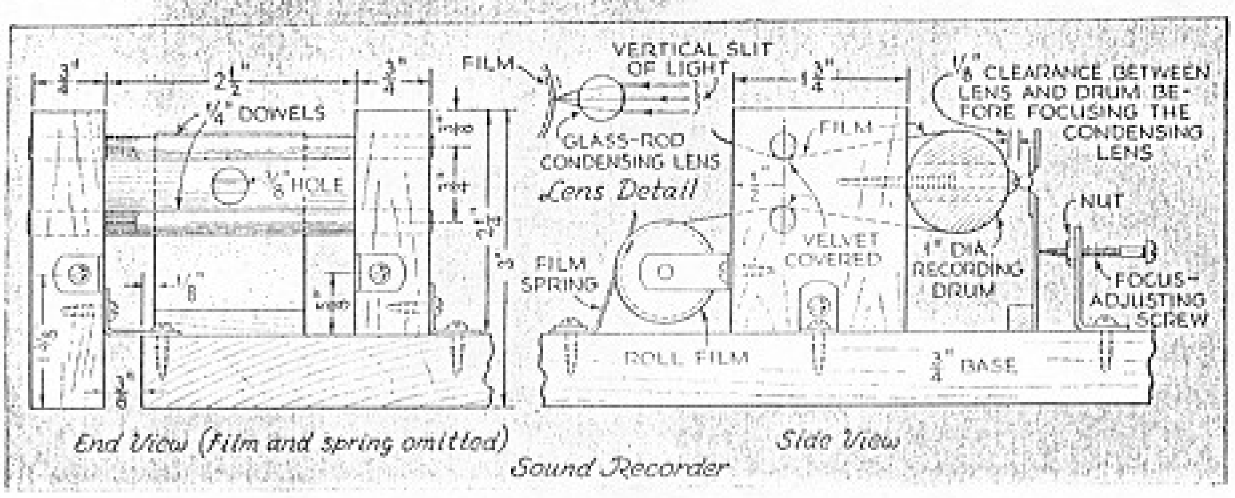
Sound-producing vibrations are impressed on a beam of light, which moves in accordance with these vibrations. This is accomplished by means of two mirrors. One is vibrated by sound waves and gives the light beam its horizontal scanning motion and the wave image its width or amplitude. The other mirror revolves and spreads out the image in a vertical direction.

If the vibrating-mirror speaker unit is connected with the radio in exactly the same way as an ordinary magnetic loud speaker (P.S.M., Feb., '34, p. 54), the sound waves will cause the mirror to vibrate. This makes a point of light on the ground glass of the scanning screen expand horizontally into a line. When viewed in the revolving mirror, this line appears in the form of sound waves such as are illustrated. Thus the sound waves are visible at the same instant they issue from the radio loud speaker.

A "home broadcast" microphone connected to the radio (P.S.M., Apr. '33, p. 62) enables you to see your own voice or any other local sounds. If the unit is connected directly to a toy train transformer at about 14 volts, the a.-c. hum of the house current is easily seen.

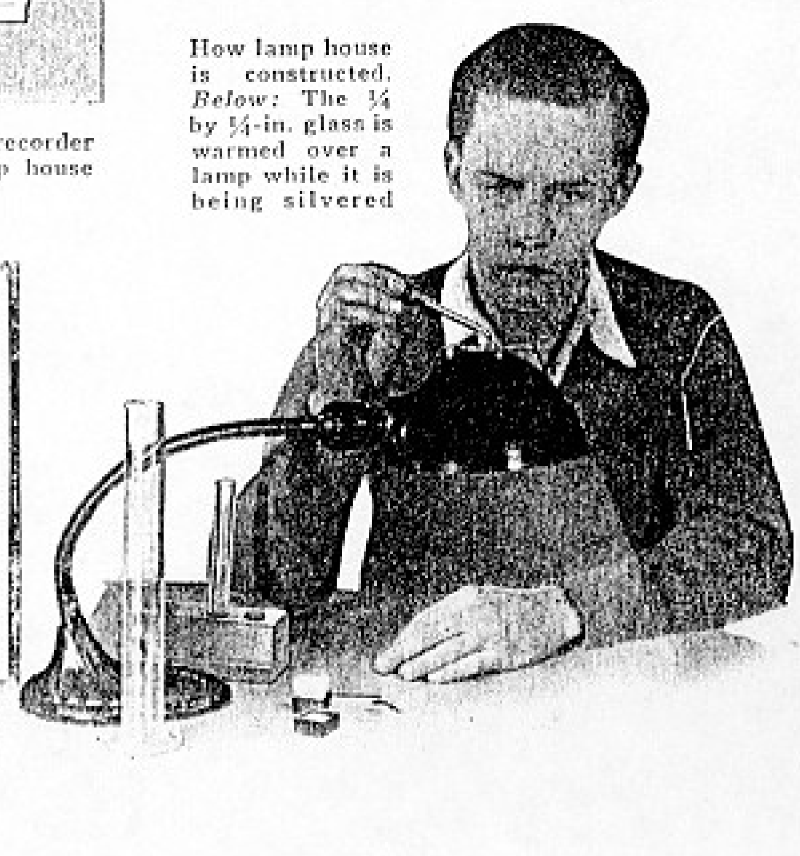
In constructing the oscilloscope, the first step after cutting the base to size is to assemble the vibrating mirror unit. This consists of an old magnetic speaker unit of the so-called "Baldwin" type, obtainable for considerably less than a dollar from most radio supply mail-order houses. Over the end of this is stretched a piece of thin rubber from a toy balloon, which is held in place with a rubber band.

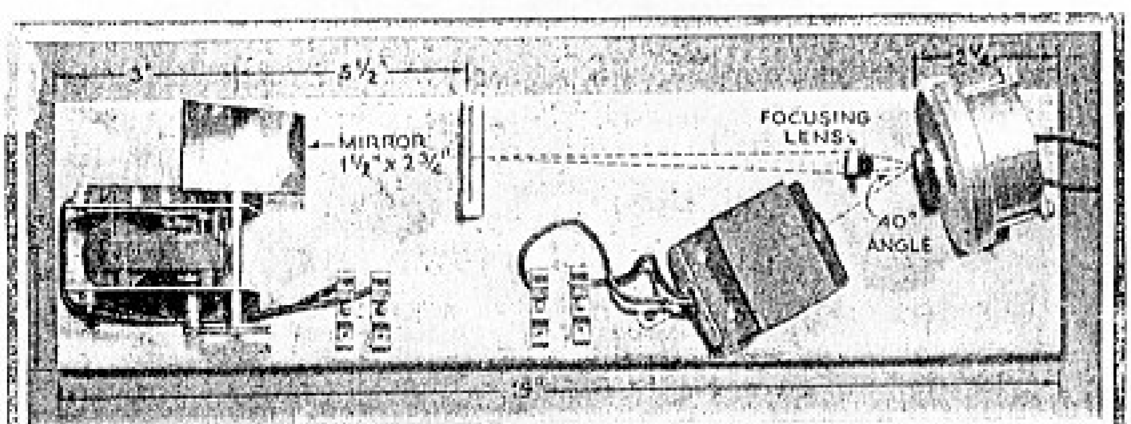
A ¼ by ¼-in. mirror, made from a microscope cover glass, is fastened to one side of the rubber with cellulose "household" cement. The cover glass is cut by scratching it lightly with a glass cutter and then carefully bending it until the glass breaks



Details of scanning screen and sound recorder, and photograph of shoe box to shield recorder against stray light. A cardboard strip helps shield the condensing lens from the lamp house

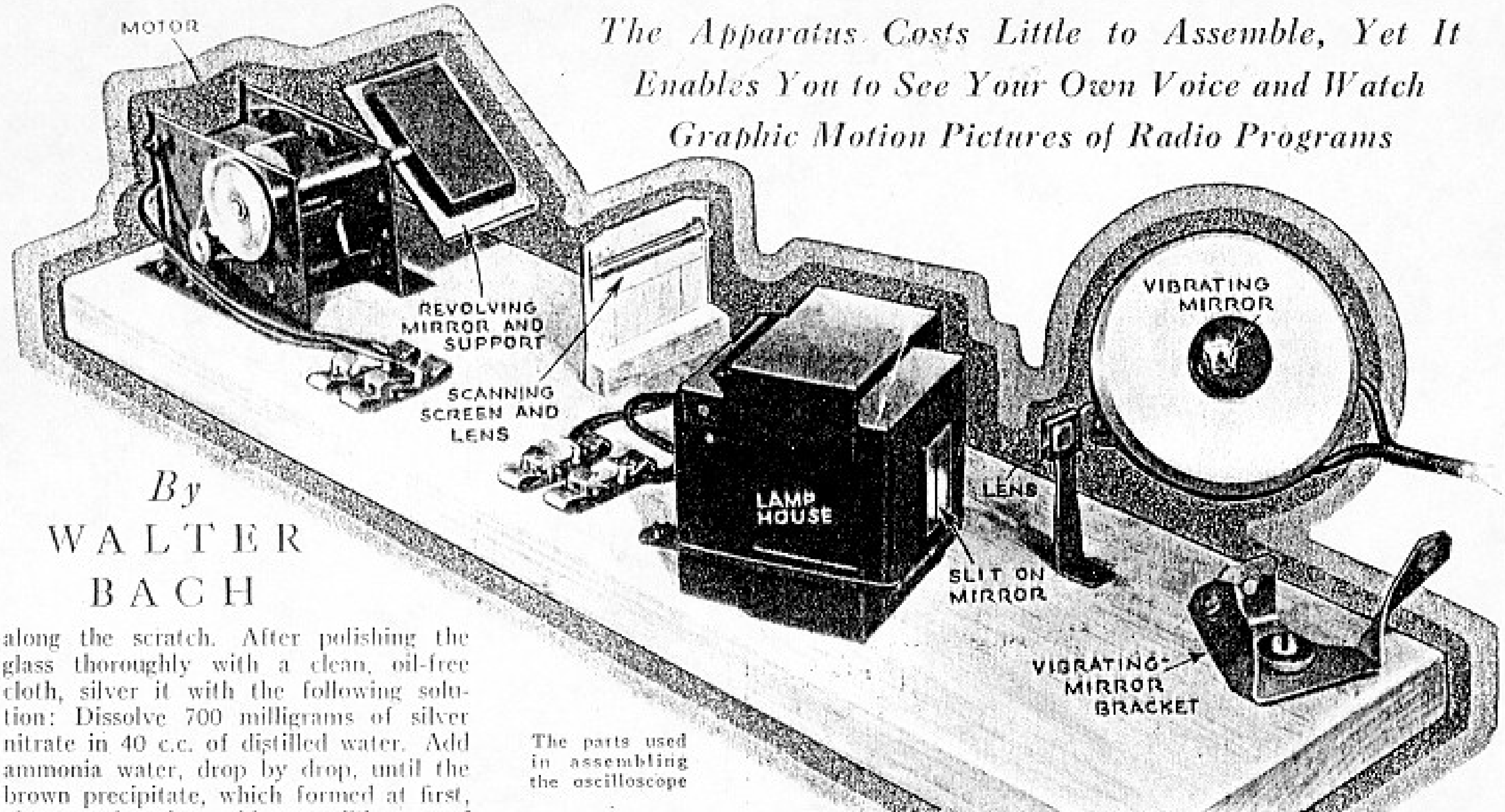
How lamp house is constructed. *Below:* The ¼ by ¼-in. glass is warmed over a lamp while it is being silvered





Top view of the apparatus. The lamp house, which may be made of thin tin or any suitable material, contains an automobile lamp and is wired for 6 volts a.c. or d.c.

The Apparatus Costs Little to Assemble, Yet It Enables You to See Your Own Voice and Watch Graphic Motion Pictures of Radio Programs



The parts used in assembling the oscilloscope

By WALTER BACH

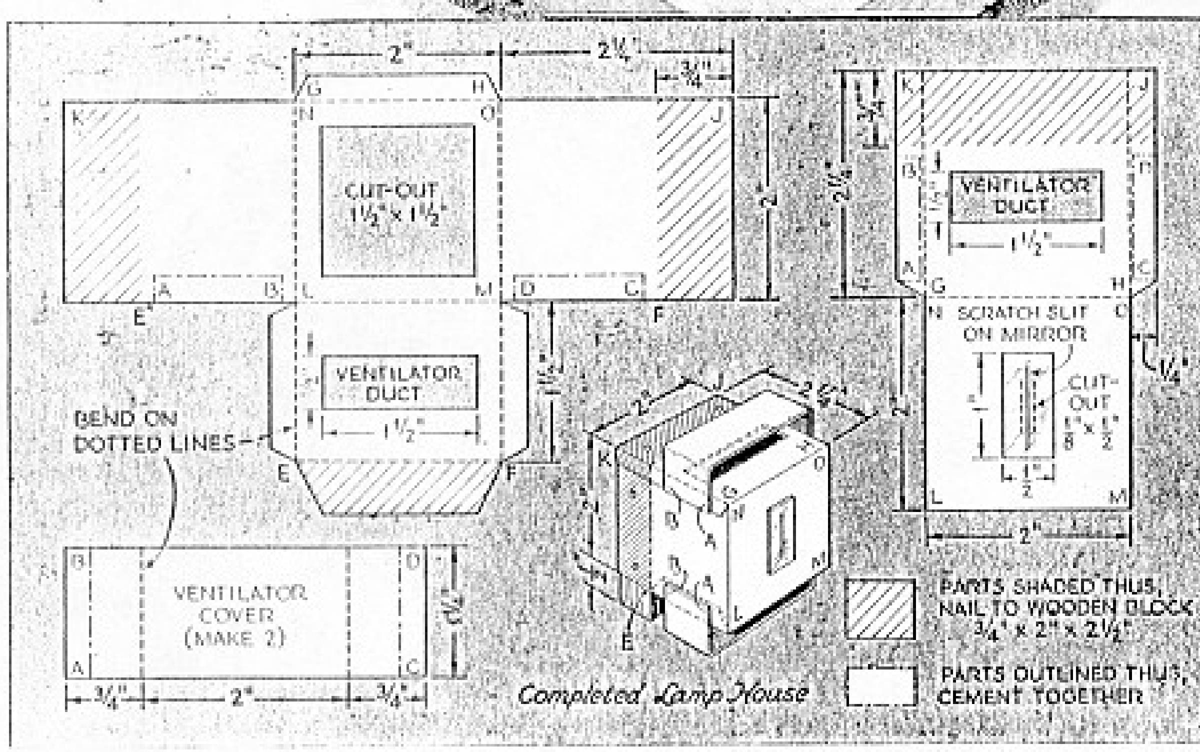
along the scratch. After polishing the glass thoroughly with a clean, oil-free cloth, silver it with the following solution: Dissolve 700 milligrams of silver nitrate in 40 c.c. of distilled water. Add ammonia water, drop by drop, until the brown precipitate, which formed at first, clears again; then add 200 milligrams of Rochelle salts. Any druggist can prepare this solution if necessary. A supporting bracket cut from sheet copper completes the vibrating-mirror unit. In the photograph at the top of this page, the unit has been removed from the bracket to show the details.

The revolving mirror is cut from an ordinary hand mirror and cemented to a wooden backing, which is attached to the shaft. The motor, pulleys, and shafting were taken from a toy construction set.

The illustrations reveal the constructional details of the scanning screen and lamp house. The lamp-house slit is produced by making a fine scratch on the silvered side of a 1 by ½-in. piece of mirror. The height of the automobile lamp filament in the lamp house, the focusing lens, and the condensing lens on the scanning screen are all determined by the corresponding height of the vibrating mirror. Measure this height from the center of the mirror to the baseboard.

The scanning screen is cemented to the baseboard with the center 1 in. from the edge of the base. With the vibrating mirror also located 1 in. from the edge, the vibrating mirror unit and the lamp house are lined up as shown in the illustrations, so that the vertical slit of light reflected by the vibrating mirror shines on the center of the scanning screen. The light beam should then travel parallel to the edge of the baseboard.

The focusing lens, taken from a ten-cent camera and cemented to a sheet-copper mount, is moved back and forth in the path of this beam of light till a sharp image of the slit on the lamp house appears on a piece of paper held against the condensing lens. The focusing lens is then cemented permanently.



When the paper is removed, the vertical slit should be focused directly on the condensing lens, whereupon a point of light will appear on the ground glass back of the lens. Any movement of the vibrating mirror causes a greatly magnified movement of this point.

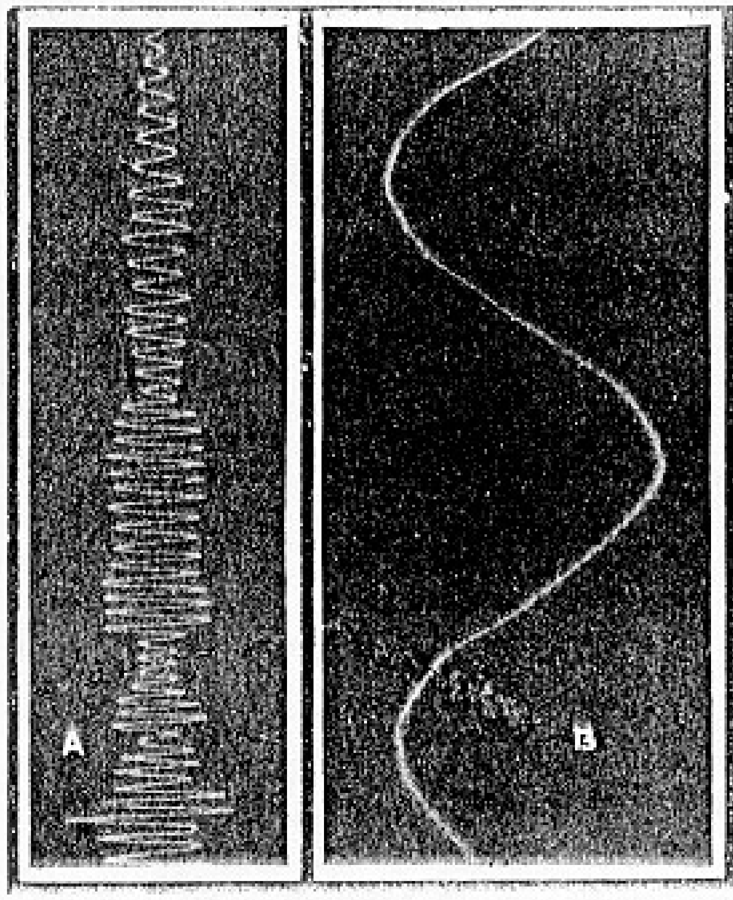
Details of the sound recorder, which records sound waves on No. 120 roll film, are shown in a drawing and one of the photographs. The two dowels used must be covered with velvet as the sensitive side of the film passes over them. The recording drum was cut from the handle of a discarded broom.

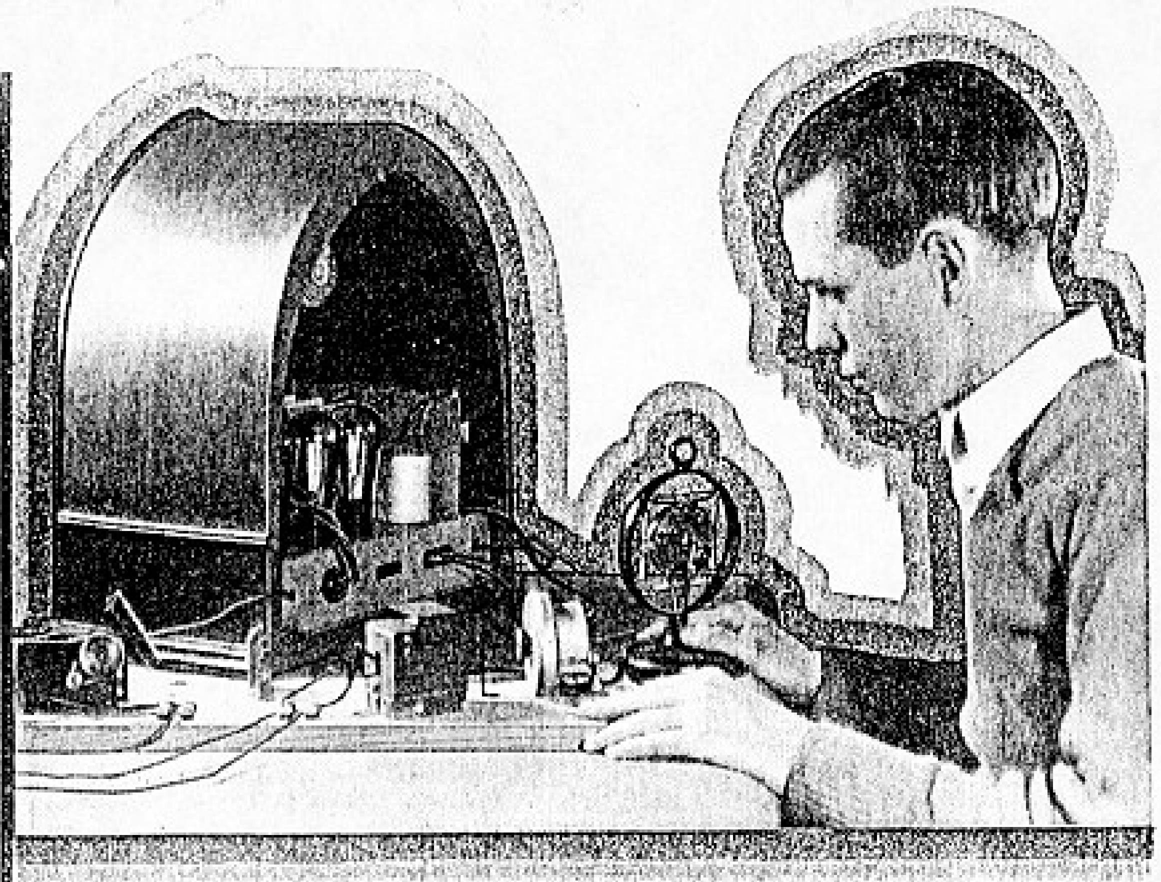
The film replaces the ground glass of the scanning screen and also takes the place of the revolving mirror unit, which should be removed. The ground glass is removed and the scanning screen turned around, but take care that the slit of light is still sharply focused on the condensing lens. The recording unit should be located with ⅛-in. clearance between the condensing lens and the recording drum, before focusing. A focusing screw is added so that the spot of light may be focused accurately on the film.

To facilitate focusing, drill a ⅜-in. hole through the recording drum directly in back of the condensing lens. By threading a piece of discarded film through the recorder, the condensing lens can be slowly moved closer to the film by means of the focusing screw until the spot of light on the film, viewed through the hole in the drum, is as sharply focused on the film as possible.

The actual recording must be done in a photographic darkroom under a red light safe for film. Thread the end of the film through the recorder, after making the recorder light-tight as shown in the photograph. With the recorder connected t the radio, pull the film past the condensing lens quickly and evenly when the sound you wish to record occurs.

Then develop the film as usual. Use ordinary film because it is not as sensitive to stray light as the faster types. The oscillograms illustrating speech and the a.-c. hum were made by this method.





The sound-wave pictures are seen in the revolving mirror at left while the sounds are issuing from the loudspeaker. A man's speech is like *A*; a power-line hum, like *B*

Continued from page 1898

tained, named by him *gallein*, which appears in the form of either a brownish-red powder, or of small metallic green crystals. If this be boiled with a good deal of water, with addition of zinc and dilute sulphuric acid, the dark color of the liquid is transformed, after a certain time, into a light reddish-yellow. Some resinous matter will be separated from this by filtering, and the liquid becomes clear; but, on cooling, is clouded again by the separation of some oil drops, which after a time become crystallized. Ultimately large brownish-red crystals are obtained, which consist of *gallin* mixed with a little gallein.

If gallin be heated with twenty parts of concentrated sulphuric acid to 200° C., the reddish-brown color of the solution changes after a time to a greenish-brown. After the reaction is completed, the mass is to be boiled in a large amount of water, and the very voluminous deposit washed with hot water. This consists of *cœrulein*—a substance readily soluble in hot aniline, with the production of a beautiful indigo-blue color. Other substances referred to in Professor Baeyer's paper are cœrulin, reforcin, fluorescein—the latter of which will impart a beautiful yellow color to silk and wool without any mordant.

Attention is called to the similarity of gallein, gallin, cœrulein, and cœrulin to the coloring matter of wood. The relationship is particularly striking between gallein and the coloring matter of logwood, and between cœrulein and the lo-kao of the Chinese.

EXPLOSIVE BALLOONS.

An interesting and amusing philosophical experiment may be made by filling the new-fashioned collodion balloons with a mixture of oxygen and hydrogen gases, and after closing the mouth of the balloon tightly with a string, allowing it to rise into the atmosphere. A fuse of filter-paper, about an inch long and half an inch broad, is to be previously gummed to the side of the balloon, near the mouth, and allowed to dry.

ELECTRO-ACUPUNCTURE OF THE ARCH OF THE AORTA.

Among the novelties of surgical science may be mentioned the use of electro-acupuncture, for the relief of aneurism of the arch of the aorta, as practiced in Italy. Experiments in this direction have been quite successful, involving no danger, and giving the patient relief from great suffering.

SUBSTITUTE FOR BICHROMATE OF POTASH.

The recent increase in price of bichromate of potash continues to exercise the minds of manufacturers, especially in Germany, in view of the fact that it is obtained from chrome irons, which occur abundantly in various parts of the world, especially in Sweden; and this increase of price is considered to be the result of a combination on the part of the manufacturers, and not a real necessity.

The use of other substances is therefore urged, by which the demand for the bichromate of potash may be reduced, and its manufacturers thereby brought to terms. A writer in one of the German dyeing journals calls attention to the fact that for many purposes, such as for coloring black, Glauber's-salt and sulphuric acid can be substituted to great advantage; and he gives the following recipe for dyeing 100 pounds of loose wool—namely, six pounds of Glauber's-salt, two pounds of sulphuric acid, and two pounds of blue vitriol, which are to be boiled together for an hour, and colored with forty to fifty pounds of logwood and one pound of blue vitriol, and finally colored black by means of a little green vitriol. The black thus obtained is pronounced to be beautiful, cheap, and easily spun, remaining loose and soft.

FRENCH PRESERVED BREAD.

A new article called preserved bread has lately been introduced in Paris as a substitute for biscuit, or hard-tack, for travelers, and for naval and military commissary stores generally. Bread prepared in the ordinary way is first submitted to a drying process for from eight to fifteen days, until every particle of moisture is eliminated. It is then compressed to the utmost, so as to occupy the least possible bulk, having been previously exposed for a short time to the action of steam in a suitable vessel. The loaves are then piled up upon iron plates with rims, which serve as moulds during the operation. These plates are then placed under a hydraulic press, subjected to great pressure, and allowed to cool there during twenty-four hours. The cakes thus obtained are placed in boxes, sealed up, and, if kept from moisture, can be preserved for many years. This bread has a vitreous fracture, but the teeth penetrate it without effort. It softens readily in soup, and for many purposes is very much superior to the preparations usually employed under the same circumstances, especially on account of being leavened.

ACRIDINE, A NEW ANTHRACENE DERIVATIVE.

A basic substance has lately been separated by Graebe and Caro from crude anthracene, to which, on account of its irritating action upon the skin and mucous membranes, they have given the name of acridine. This body is obtained by heating the semi-solid portion of coal naphtha, which boils between 300° and 360°, with dilute sulphuric acid, and precipitating the acid solution with potassium dichromate. A dirty brown precipitate is obtained, which dissolves on repeated treatment with boiling water. The solution thus obtained yields, after filtration and cooling, orange-yellow crystals of the chromate of the base; these crystals, freed from the mother-liquor by washing, yield the free base when warmed with ammonia. Thus obtained the body is not quite pure; but it may be rendered so by recrystallizing its hydrochloride. Acridine substance crystallizes, as determined by Dr. P.

Continued on page 1907

YOU, TOO, CAN Photograph Children LIKE AN EXPERT

The study above by Mr. Lissaman has been hung at various photographic salons, here and abroad. The data: 1/25 second at F/6.3. Four No. 1 photofloods in pairs; diffusion screens over reflectors

POPULAR SCIENCE MONTHLY
MAY, 1938

By REGINALD O. LISSAMAN

PHOTOGRAPHING children is a fascinating pastime, and it can also be made to pay good dividends. Given a fair camera and a little homemade equipment, any amateur familiar with the fundamentals of picture making should be able to turn out child story-telling pictures and portraits surpassing those of the average professional. While the amateur's results may for a time lack the finish of the expert, he can catch the spontaneity of expression that is so hard to get from a child in the strange environment of the studio.

All three accompanying illustrations were taken in my own home with purely amateur-type equipment, and while some of their beauty is due to fair technique, their attraction lies mainly, as you may see, in the beauty of expression, unposed and natural.

If you own a camera of the simpler type that permits focusing only at distances greater than six feet, you should obtain a portrait attachment. This is an auxiliary lens which slips on over the regular lens and permits focusing as close as thirty inches. They come in both regular and diffusion types, complete with tables of distances and camera settings. While diffusion may be introduced later in printing from the negative, the diffusion obtained at the original exposure possesses a particular beauty of its own and also tends to soften some of the photographer's errors of harsh lighting. When, however, the attachment is to be used for other work as well as portraits, the regular type is the best to buy. The picture of the two children was taken through the regular attachment, while the portrait below it was taken through the diffusion type. Note the slight softening of detail in the latter picture.

Portrait taken with same speed, stop, and lights, except No. 2 photoflood lamps were used. Both photos were made with an old roll-film camera, adapted to use cut film

"Quite Happy." Here the lights were at almost equal distances on either hand from the sitter. As the lights approach this position, the modeling is given flatter rendering

The film used for this work should preferably be of panchromatic type, since even the brilliance of photoflood lamps is low in photographic light, when compared to the sun.

All the illustrations were taken with photofloods. Information and tables regarding their use are obtainable at almost any shop that sells film. The No. 2 size is more economical than the smaller No. 1 lamps. A reflector should be used. My reflectors each hold two bulbs, and I use two reflectors. Regardless of what type of reflectors you have, each should be equipped with a diffusion screen. This is made from a piece of very

thin, cheap silk (or tracing cloth), and is large enough to cover the front of the reflector.

The equipment should be all ready before the child or children are called in. If the background (wall paper or paint) is not of a comparatively soft shade and design in the room you are to use, then a plain white or light-colored sheet should be suspended over the wall for a background. You will find, as you progress, that a white background can be rendered photographically as any shade you wish, from white to very dark. This is governed by the light which falls upon it. The farther the lights and subject are away from it, the darker it will become.

For a start the model position should be about three or four feet from the background; the lights at least that far away again.

THE camera position will be governed by the amount you include in the picture and the angle, but for normal results should be at the eye level of the model. The camera should always be on a firm support or tripod.

Lay near the camera a few "props" in the nature of books or toys, but avoid having too many objects appear in the picture. Simplicity is one of the major attractions in a portrait.

Now bring in the child (or children). Play with the child, show him where you want him to stand or sit, but make no attempt to pose him. Get the child to forget the camera and become so absorbed in your conversation that he even forgets himself. A gentle reminder as to position may be introduced from time to time, but do not make the desired position of paramount importance.

Formal portraits with full attention apparently directed toward the camera are very little more difficult. You simply replace the interest-creating object with a story or with absorbing conversation. The little boy in the portrait was listening intently to a deeply interesting (to him) conversation on the habits of gophers.

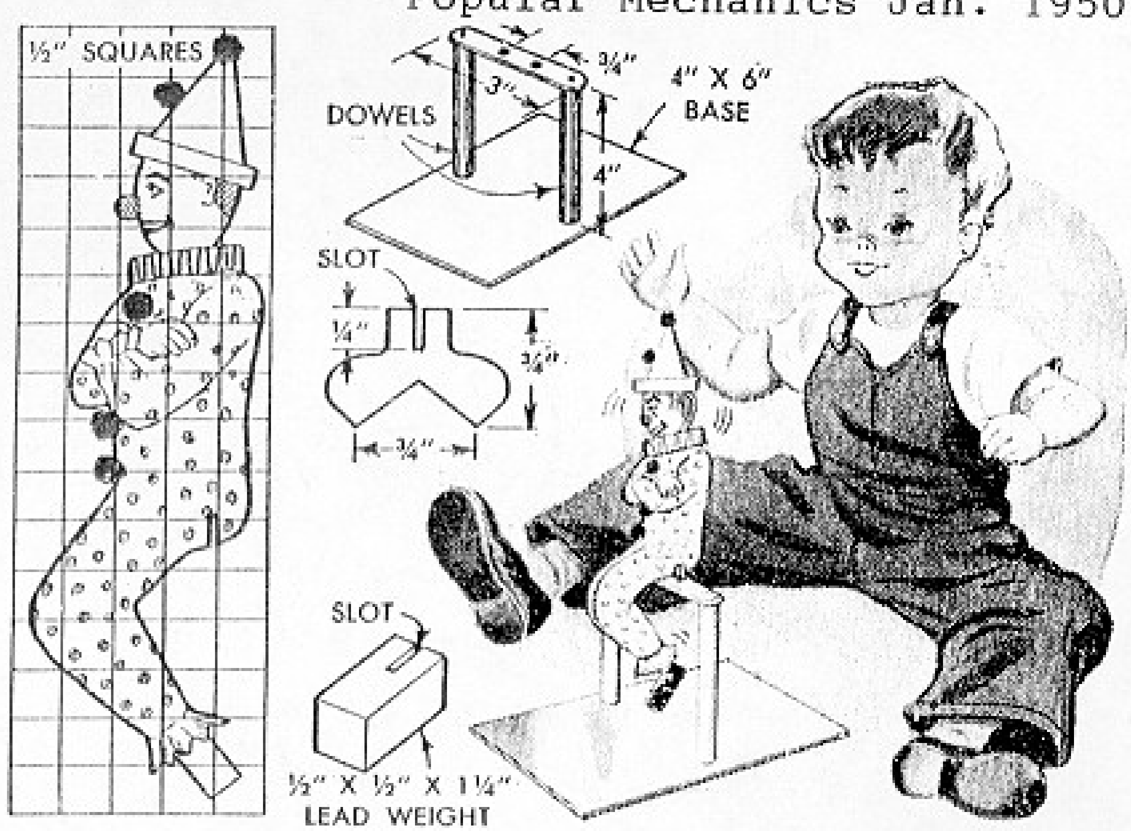
The primary thing, of greatest importance to remember, is that portrait lighting should be simple. The light should come fundamentally from but one source. Although we shall assume you are going to use two lights, the first is placed relatively close so as to light the subject, but the second light is at a greater distance to light up the shadows cast by the former. These shadows should still be shadows, yet illuminated well enough to show a degree of "tone" on the finished print. The amount of light to throw into the shadows is determined largely by experience.

If the light is coming from two equal sources, each illuminating a side of the model's face, and if the secondary source is twice as far from the model as the first, then the light falling on the model's face from the secondary light is not one half as intense as that from the first, but has only one quarter the intensity. This fact should be relied upon in determining the range of contrast you wish from highlight to shadow. (Negative development also controls contrast but will be overlooked, since only lighting is being discussed.)

The placing of the lights should be somewhat as follows: The dominant light, for normal effects, should preferably come from above. The well-established 45-deg. lighting is suitable for the beginner. This calls for the first and nearer light to be about 45 deg. to one side and 45 deg. above the model's head and, of course, in front of model. The second light is placed, for a start, about twice as far from the model as the dominant light, and about camera level. It is on the side of the camera (and model) opposite the dominant light. This second light is now in a good position, being lower than the first, to throw some light into the shadows cast on the face by the various features.

Weighted Toy Clown Swings Precariously on Rail

Popular Mechanics Jan. 1950



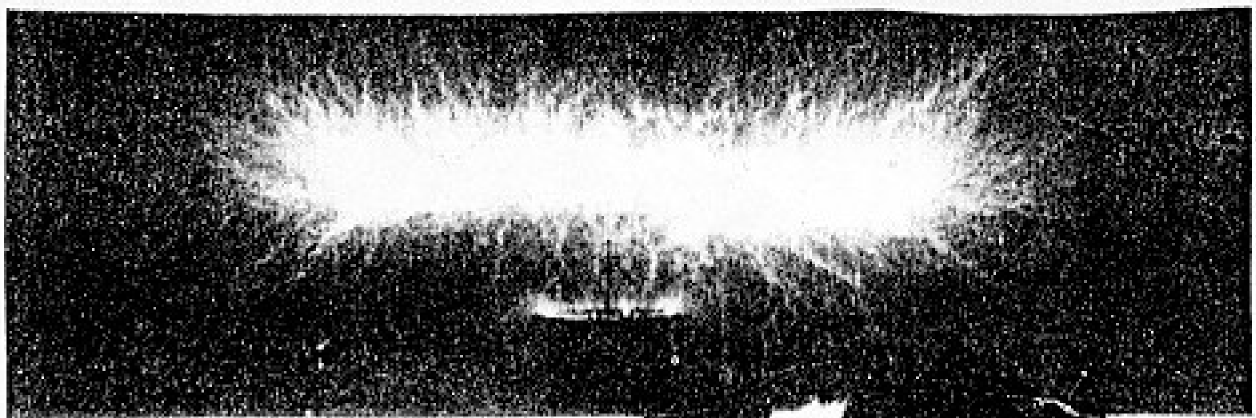
A flick of the finger starts this funny clown swinging merrily back and forth on his uncertain perch. To make the toy, cut the clown from sheet metal according to the squared pattern and paint it in bright colors. The base, which is a piece of plywood or sheet metal, supports two dowel uprights fastened with screws driven from the underside. A sheet-metal or plywood crossbar is attached between the uprights. If sheet metal is used for the crossbar, drill two holes for the sheet-metal pivot member or, if the bar is of plywood, countersink two depressions for the pivot and drive a small carpet tack in the bottom of each depression to reduce friction. Slot the pivot and the clown, as shown, and solder them together. Then, slot a lead weight and squeeze it tightly over the end of the clown's leg.

Rudolph G. Kopp, Milwaukee, Wis.

STUNTS WITH High-Frequency Current

POPULAR SCIENCE MONTHLY
NOVEMBER, 1935

By KENDALL FORD



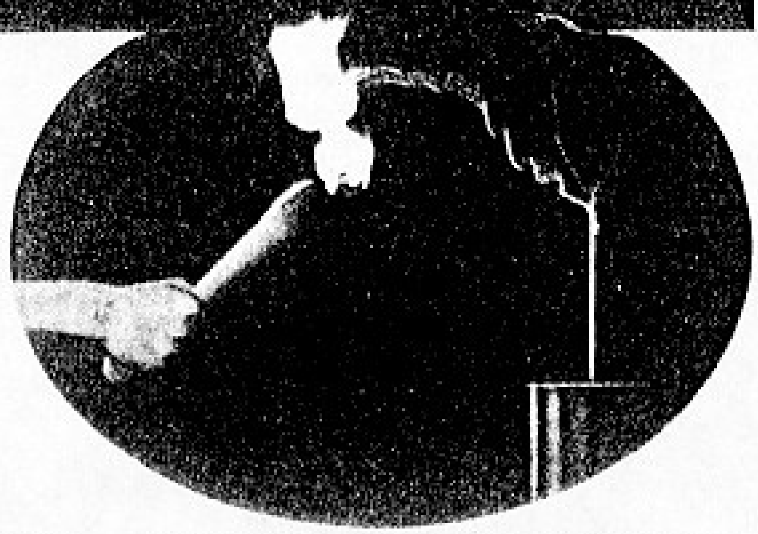
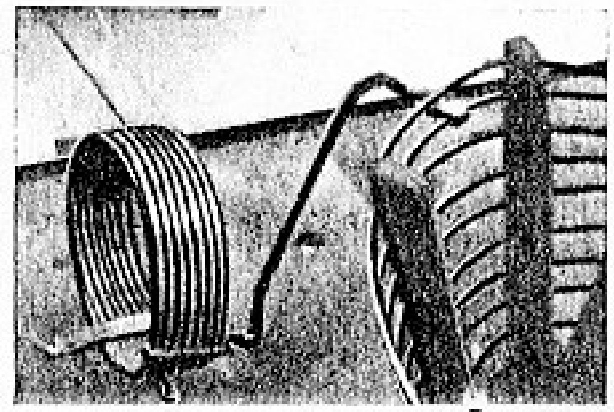
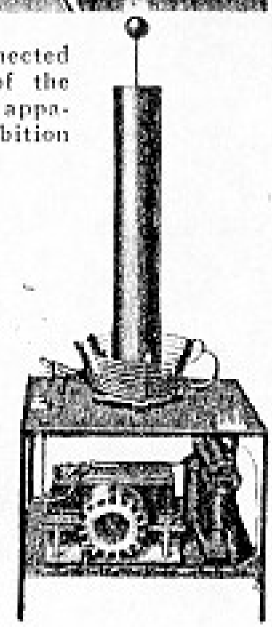


Photo taken at night of weird 6-ft. halo produced by a revolving wire. *Right:* Setting a torch on fire from the high-frequency spark discharge

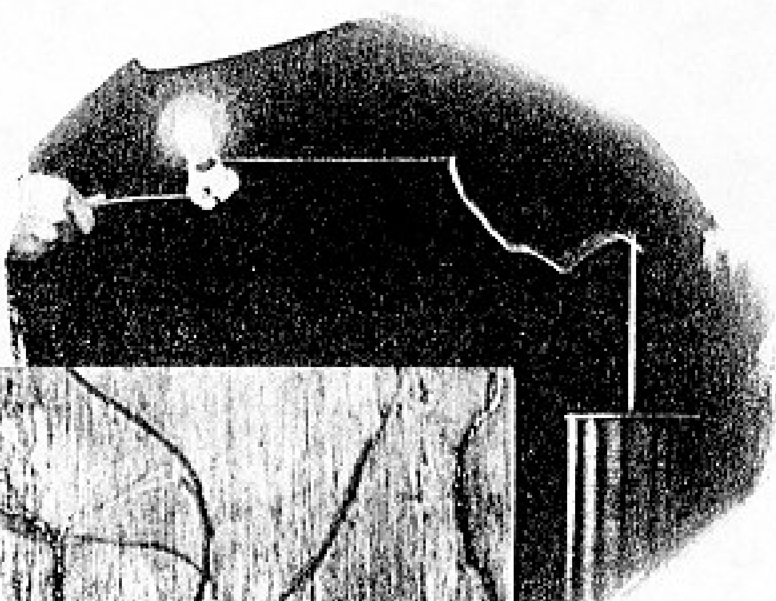


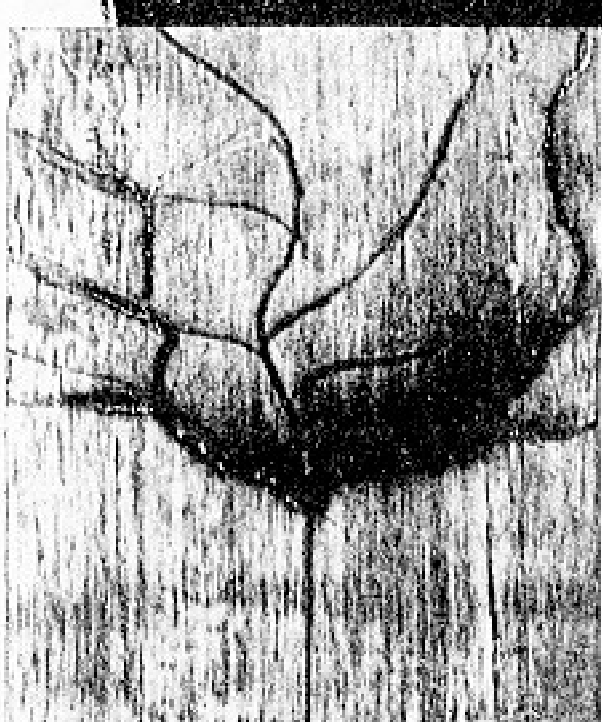
How loading coil is connected and, at right, a view of the 36-in. high-frequency apparatus arranged for exhibition



READERS who have followed the constructional articles on high-frequency apparatus that have appeared in past issues will be interested in learning how some of the amazing experiments are performed. The 36-in. high-frequency coil and its associated apparatus (P. S. M., May '35, p. 82, and July, p. 82) will be used for the purpose of illustration in this article.

The 110-volt line current is stepped up to approximately 12,000 volts by means of the transformer. The high-voltage current flows from the secondary of the transformer into the condensers, which become charged. If the circuit comprising the condensers, primary of the high-frequency coil, and spark gap has been properly adjusted, the condensers will discharge across the spark gap with a series of sparks, the frequency of which is many times the original 60-cycle charging current.





Ordinary electric lamp lighted by discharge, which then passes into experimenter's body without doing the least harm

A tree design burned into a dry board with high-frequency current. This stunt is a striking spectacle in the darkness

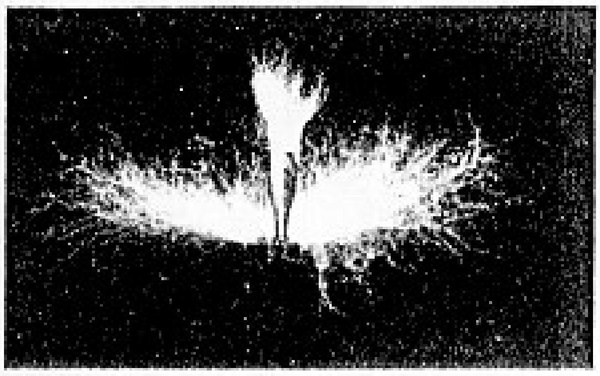
The high-frequency discharge of the condensers is somewhat analogous to the swing of a pendulum. The 60-cycle current that charges the condensers may be likened to the single motion required to start the pendulum from rest, and as the swing of the pendulum will gradually diminish until it comes to a standstill, so will the strength of the discharges from the condensers across the spark gap gradually diminish until the condensers are discharged. These rapid discharges from the condensers occur between the peaks of the 60-cycle charging current, and in a properly adjusted circuit they in no way interfere with the charging current. Where a rotary spark gap is used, it has the effect of still further increasing the frequency of the spark several hundred times a second. Since high-frequency current travels over the surface of a conductor, or along the skin of a human being, it may be readily understood why a person may take a high-frequency discharge of several hundred thousand volts and suffer no ill effects.

As the 12,000-volt high-frequency current flows through the primary winding of the high-frequency coil, a current is induced in the secondary coil, the terminal voltage of which depends upon the ratio of the secondary to the primary turns. The voltage induced in the secondary coil is proportional to the number of secondary turns, and at a point along the secondary even with the top of the primary coil the voltage is high enough to produce a spark several inches long. To avoid sparking between the coils at that point, the primary coil is tapered away from the secondary.

The importance of properly adjusting the high-frequency circuit cannot be too strongly emphasized. The author has seen high-frequency apparatus where merely adding a portion of a turn to the high-frequency coil primary changed the discharge from a weak, stringy spark to a mass of beautiful long streamers. For greater flexibility and as a means of adjusting the coil to its maximum output, it is suggested that an additional loading coil be inserted between the condenser lead and the primary coil. Six to ten turns of bare copper or brass wire wound on a cardboard or wood form 6 to 8 in. in diameter will be quite satisfactory. Any size wire larger than No. 10 will do, and it should be spaced so the connecting lead may be clipped to any turn.

If the stationary electrodes of the rotary spark gap are separated too far from the revolving studs, a spark will occur only in unison with the 60-cycle charging current, and this may be decidedly unpleasant to take

through the body. The proper separation will depend upon the speed of the rotary part of the gap. It may usually be determined by the sound of the

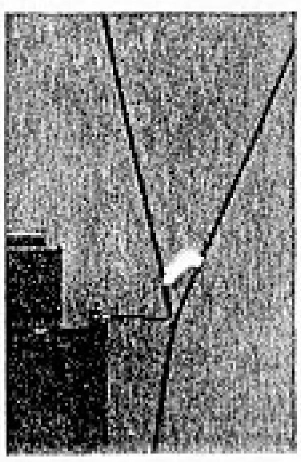


Night picture of the discharge as it plays freely around and through a common bottle

spark. When a pure musical note is given off by the discharge across the gap, the adjustment may be considered correct. The maximum separation between the gap elements should not in any case exceed 1/16 in.

When operating high-frequency apparatus for the first time, especially in broad daylight, the experimenter is apt to be somewhat disappointed with the results. Only the strongest sparks will be visible in a bright light, and the beautiful brush discharge will be completely lost. Some views of spectacular night displays are shown. Of particular interest is the 6-ft. halo produced by the revolving wire described in the May issue.

If a small branch of a shrub or tree is fastened to the discharge rod of the coil, it will wilt and collapse almost immediately after the current is turned on. If the discharge is continued, the branch will burst into flames within a few seconds. If a dry, well-seasoned board is placed against the discharge rod, the spark will branch out and slowly creep to the top and sides of the board. At night the spectacle appears like a luminous tree slowly taking shape before the spectator's eyes.



Jacob's ladder produced with the high-voltage transformer

A stunt that never fails to mystify the layman is the lighting of a lamp with the current flowing through the lamp into the body. This may be performed by holding a lamp with attached wires and socket between the experimenter and the discharge spark, or by placing the lamp between two persons, one of whom is taking the discharge through a metal rod.

A neon-gas tube will light up weirdly if held within several feet of the spark. Outlines of figures and letters, if formed from a continuous piece of wire and suspended in the air with string, will glow with a strange blue light when the end of the wire is connected to the discharge rod.

Another interesting experiment may be performed by lighting a torch with the spark. The torch may be shaped from a piece of wood, one end of which is hollowed out to hold the burning material. A bare wire should extend from the hollowed end to the part that is held in the hand. If the hollowed end is filled with cotton waste or bits of cloth and brought near the spark, it will immediately burst into flame. The effect may be enhanced by previously saturating the waste or cloth with kerosene.

Ordinary insulators become excellent conductors for the high-frequency discharge. If a glass bottle is placed over the discharge rod, the sparks appear to meet little or no resistance in passing through the glass.

Some interesting stunts may be performed with only part of the apparatus. If the high-frequency coil is removed from the circuit and a coil of insulated wire connected in place of the high-frequency coil primary, an interesting demonstration of electromagnetic induction may be given. A second coil is made, to which is connected a socket or receptacle. The diameter of the coils may be any size that will hold its shape, and each coil may consist of from four to ten turns. If a lamp is placed in the socket and the lamp coil brought near the stationary coil, the lamp will light brilliantly when the current is turned on. If the lamp coil is moved back and forth before the stationary coil, the extent of the magnetic field may be readily observed. Since the action of the coils is similar to a transformer, the experimenter may vary the number of turns in each coil and note the various distances at which it is possible to light the lamp. In this experiment all connections remain the same as when using the apparatus for a high-frequency demonstration except that the two leads that formerly went to the primary of the high-frequency coil are connected to the ends of the stationary coil.

By attaching two bare wires to the terminal posts of the high-voltage transformer, the novel effect of a Jacob's ladder may be produced. The wires are arranged so that they come within 1/4 in. of each other at one point, then slant upward and away from each other at an angle of about 45 deg. to a height of about 10 in. from the point of closest separation. When current is applied to the primary of the transformer, an arc will form across the points of least separation, and will then climb upward until it reaches a gap of several inches, where it is extinguished, only to be followed by a series of arcs as long as the current is on.

Although the discharge from a high-frequency coil may be taken with no ill effects, the spark should not be allowed to play on the bare skin, otherwise a painful burn may result. If the spark is taken through a metal rod held in the hand, the possibility of burns is eliminated. Caution should be exercised when working around the high-voltage transformer circuit, or when performing experiments requiring the transformer alone.

Continued from page 1903

Groth, in small, four-sided, rectangular prisms of the rhombic system, whose edges are often, but narrowly, truncated by the vertical prism, while the ends are formed by obtuse domes.

Acridine melts at 107°, and distills without alteration at a temperature above 360°. It sublimes, even below its melting-point, in large, broad needles. It is almost insoluble in cold, and but little soluble in boiling, water. On the other hand, it dissolves readily in alcohol, ether, carbon-bisulphide, and hydro-carbons. The dilute solutions show a beautiful blue color by reflected light. It exerts a slight but distinct alkaline reaction on litmus. When inhaled, either in dust or vapor, it causes sneezing, and in large quantity coughing. It is exceedingly stable, and may be distilled unaltered over either ignited zinc or soda-lime, although most readily attacked by sodium amalgam. Two series of salts of acridine have already been prepared by the authors, and numerous compounds with other substances examined by them.

BREEDING OF OSTRICHES IN CAPTIVITY.

We have already referred to the subject of the breeding of ostriches in captivity in Europe, and are reminded that this is a practice of common occurrence in South Africa, where large numbers are kept for the purpose of securing successive crops of their feathers, and are inclosed in areas of fifteen to twenty acres, encircled by low stone walls. Their eggs are usually hatched artificially by being kept at a temperature of about 100 degrees by the aid of an oil lamp. The long white feathers of the wings of the male birds are the most valuable, bringing from $150 to $200 a pound, eighty feathers usually making up this weight. The feathers from the wild birds are, however, considered more valuable than those taken on the farms.

SENSIBILITY OF IRIDIUM, ETC., TO MERCURIAL VAPOR.

Professor Merget, in a communication to the Academy of Sciences of Paris, states that when solutions of iridium, platinum, and other metals in nitro-muriatic acid are brought into relations with metallic mercury, their sensibility is so great that if a paper be impregnated with such a solution and exposed to the vapor of mercury, in however small a quantity, it becomes colored black, forming, as it were, an actual indelible ink. From his experiments the author infers that mercury evaporates with a velocity of 180 meters per second, and reaches to a height of 1700 meters. A practical test of these experiments of Professor Merget shows that by means of iridium paper so prepared, the presence of mercury can be ascertained in the atmosphere of all workshops where this metal is employed, especially in looking-glass manufactories. It also shows that the clothes, hair, etc., of a workman who has spent an hour in such an establishment become entirely impregnated with mercury, and that it is only necessary to bring his hand near paper prepared with iridium in order to have it instantly outlined in black. It is not at all impossible, according to Professor Dumas, that this discovery may be the initiation of a method by which the reproduction of objects in nature and art may be accomplished in a degree of perfection far exceeding any thing known at present, both in point of rapidity and economy, not excepting photography. Specimens actually exhibited to the Academy of Sciences in the new art of mercuro-typy are very encouraging in their promise.

FUNGI IN POTABLE WATER.

Professor Frankland has lately been renewing the experiments of Dr. Heisch in regard to the development of fungi in drinking-water, in the course of which he found that when sugar is added to waters contaminated with sewage a fermentation ensues, with a rich growth of fungi. Meeting some unexpected exceptions, however, in the course of his investigations, to the result indicated above, he instituted a series of experiments, and finally deduced the following general results, according to the *Chemical News:*

1. Potable waters mixed with sewage, urine, albumen, and certain other matters, or brought into contact with animal charcoal, subsequently develop fungoid growths when small quantities of sugar are dissolved in them, and they are exposed to a summer atmosphere.

2. The germs of these organisms are present

Continued on page 1915

POPULAR SCIENCE MONTHLY
MARCH, 1936

Sensitive Electric Eye Made *from a* Copper Disk

Magical little device will operate a photographic exposure meter or automatic garage-door opener . . . It will guard rooms, turn on lights, and do many stunts

By Kenneth Murray

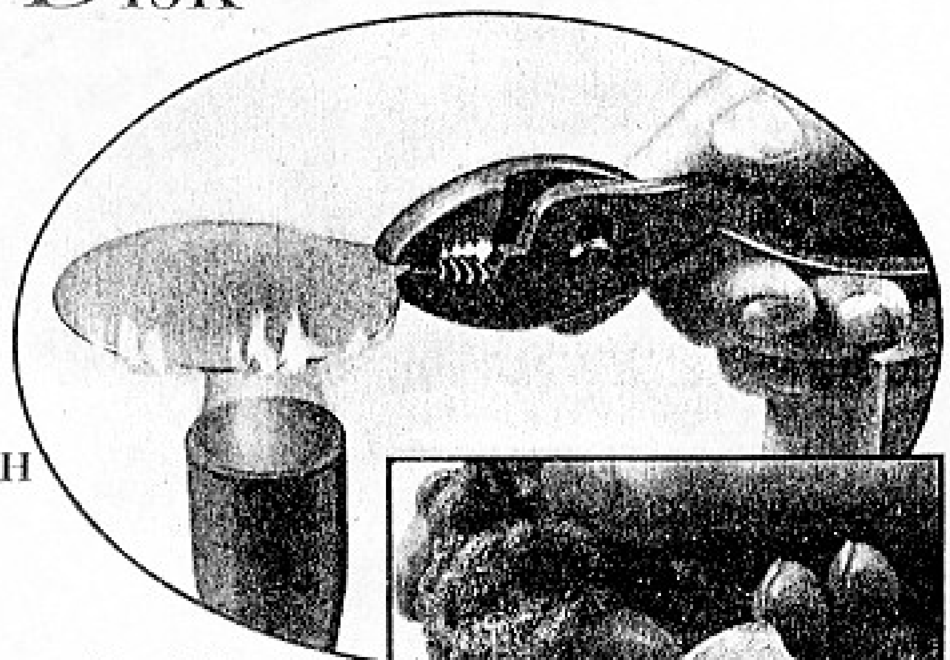
WORKMEN passing between the sun and a bank of copper oxide rectifier disks were responsible, a few years ago, for the discovery of a new type photocell or the so-called "electric eye." It was found that light falling on a disk of copper covered with cuprous oxide was converted directly into an electric current.

After a great many experiments the new electronic dry disk cell has been improved until it is now used for measuring room light in tests to prevent eye strain, for photographic exposure meters that function automatically, and for various counting operations in manufacturing plants. One inventor even went so far as to connect a sufficient number of the cells to supply enough power to run a small electric motor for demonstration purposes.

The electronic cell requires no outside current for operation and there are no liquids to spill or glass bulbs to break. One of the cells can be housed in a casing the size of a pocket watch, and carried as easily.

The manufactured cells of this type will give a current of over 5 milliamperes in daylight. The efficiency of a homemade cell depends on the care with which it is constructed, but is sufficient to operate a sensitive relay. It can be used for turning on the lights in a room when it becomes dark outside, opening garage doors, ringing bells when a beam of light is interrupted and other practical applications. For measuring light it is connected directly to a sensitive meter, such as a direct-current milliammeter or microammeter, and a special dial is calibrated for the purpose.

For making the disks, you will need pure sheet copper, 1/32 in. thick. The strength of the current depends on the size; the disk illustrated has a diameter of 2¼ in., but smaller sizes can be used satisfactorily. Leave a lip on the edge so that it can be grasped with pliers (Fig. 1). Dip the disk in water, flow it with nitric acid until the surface is absolutely clean, then rinse in water and dry with a clean cloth. It is important that the disk be perfectly clean.



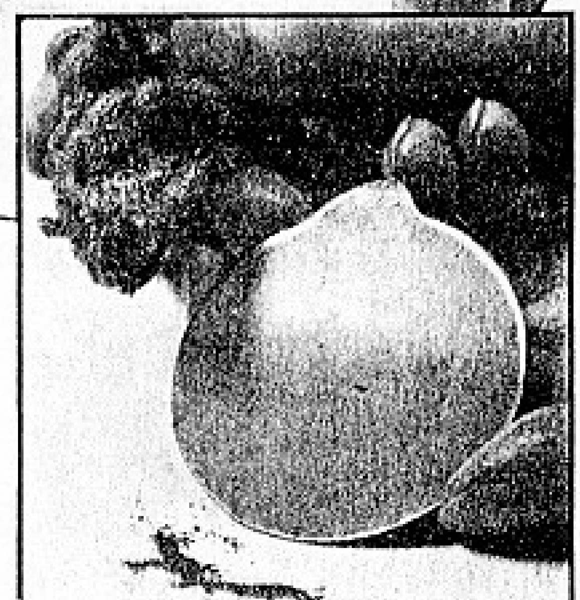


Fig. 1. The disk is heated to red-hot for several minutes and cooled on a cold metal surface. The thin layer of black cupric oxide is removed with steel wool as at right

Cuprous (copper) oxide is formed on the disk by subjecting it to a red heat for several minutes over a Bunsen burner, as shown in Fig. 1. Move it about so that all parts will be evenly heated, then lay it on a cold metal surface (such as a heavy steel saw table) to cool. The outer surface will be covered with a thin layer of black cupric oxide, which will loosen itself from the surface by this cooling method and can be readily brushed off with fine steel wool.

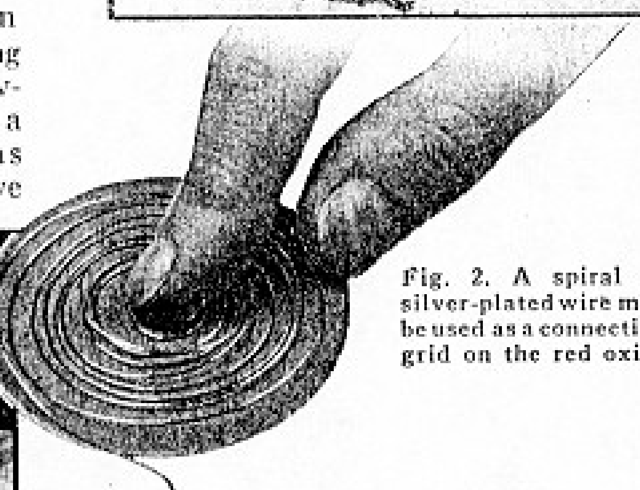


Fig. 2. A spiral of silver-plated wire may be used as a connecting grid on the red oxide

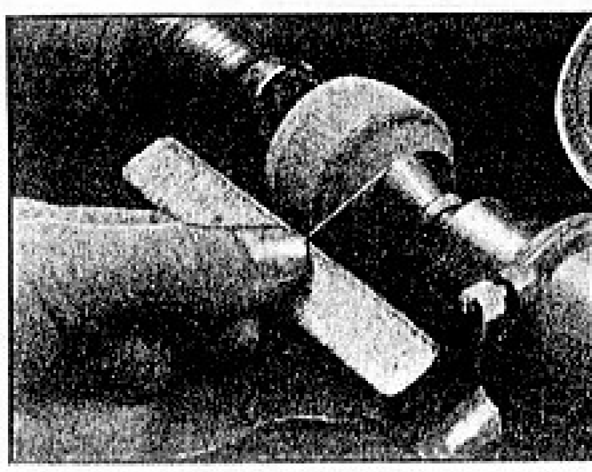


Fig. 3. An easy way to form the spiral grid is to wind the wire on a wooden cone as shown at left

Be very careful not to remove the layer of red material, which is the photoactive cuprous oxide and lies immediately under the black oxide film. If the red oxide becomes scratched or worn through to the copper underneath, the disk must be cleaned and reheated, otherwise it would short-circuit the finished cell and a current would not be produced. Usually the extreme edge of the disk will lack the red oxide coating, so the coat of silver or the wire grid, which is to be applied next, is not allowed to reach the edge.

Held in the light, the cell will now generate a current between the oxide and the copper, the latter being positive and the oxide negative. So that the current may be usable, connections must be made. The back of the disk can be cleaned with emery paper for one connection. To lower

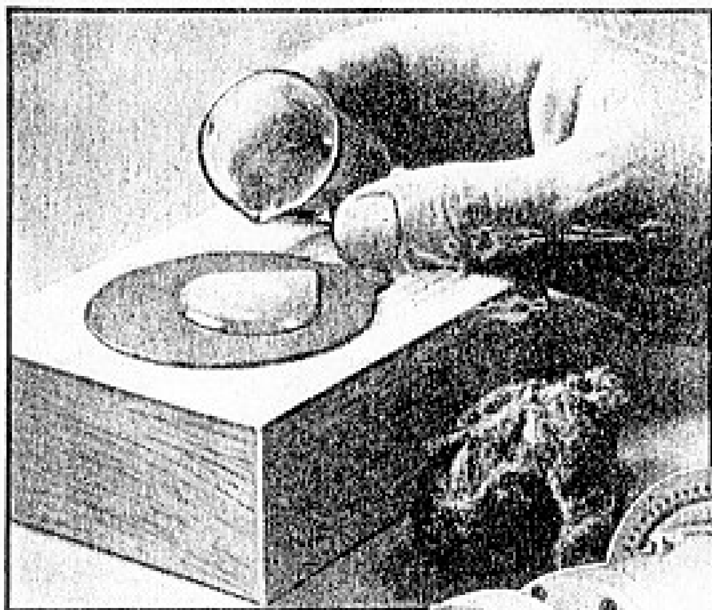


Fig. 4. The silver solution is flowed on

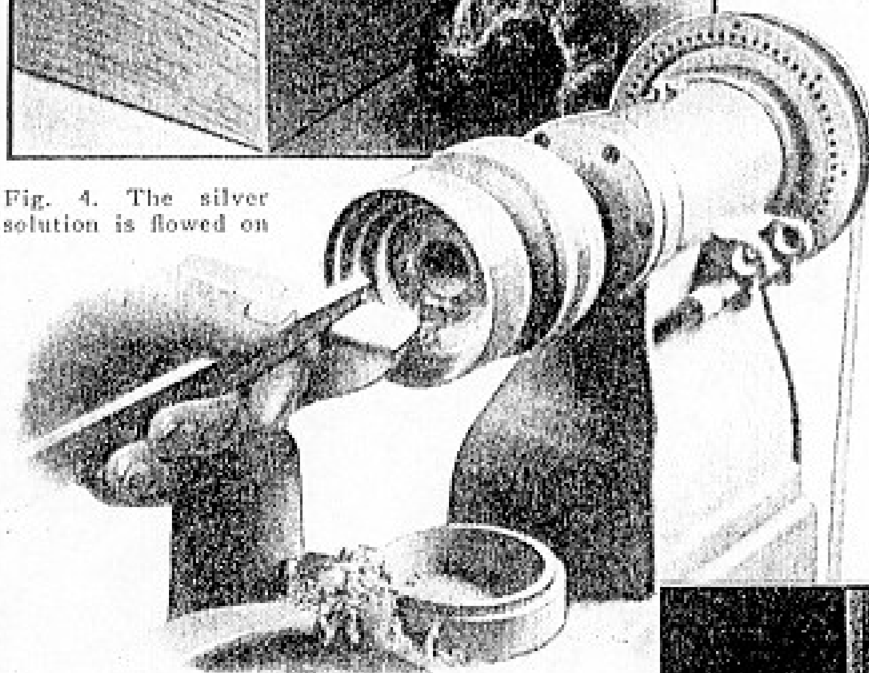


Fig. 5. That half of the wooden box for housing the photometer must be turned in a series of steps. A full-size drawing is given below

the resistance on the face side, however, the surface of the oxide must be partly covered over with a grid, which can be a coil of silver-plated wire or a coating of pure silver.

THE wire grid is less efficient, but easier to apply. Use 30-gauge wire, forming it into a spiral to cover the oxide (Fig. 2) and holding it in tight contact by means of a cover glass. Allow one end to project from under the glass for making a connection, but see that it does not touch bare copper. A good way to make the grid is to wind the wire on a wood cone, as shown in Fig. 3.

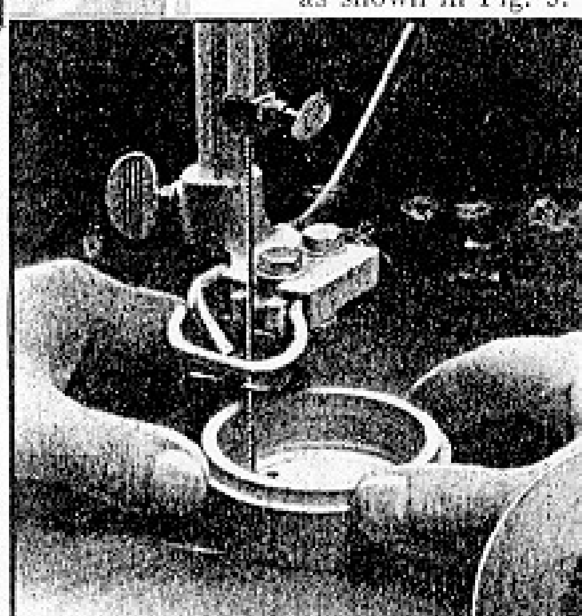
Coating the oxide with a thin, transparent film of silver is a more delicate operation, but gives more satisfactory operation. It is done chemically by pouring a special silvering solution over the oxide, allowing the silver to precipitate, and then gently washing and drying. Level the disk when flowing with the solution, so that the latter will form a circular pool as in Fig. 4.

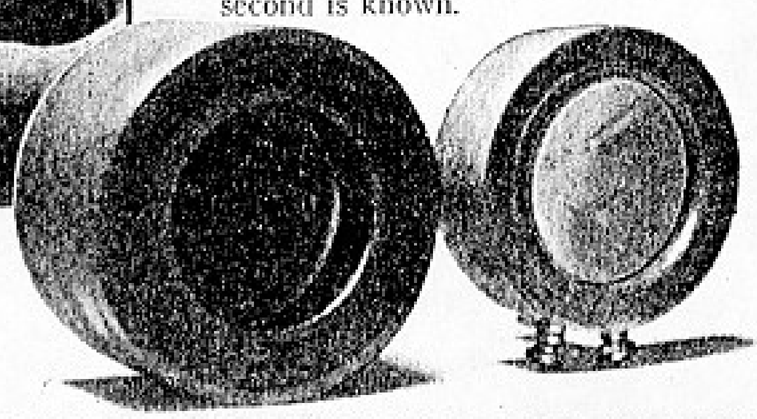
Use distilled water for the solution. Make up ten percent solutions of ammonia, caustic potash, and Rochelle salt. In 1 oz. water dissolve a crystal of silver nitrate the size of a safety-match head, and add drops of ammonia solution until it becomes almost clear after first turning brown. Add a drop of the potash solution, then more ammonia until it is almost clear again. The solution should be slightly cloudy; if too much ammonia is used, it will dissolve away the cuprous oxide on the disk. Stir in one drop of the Rochelle salt solution and use immediately.

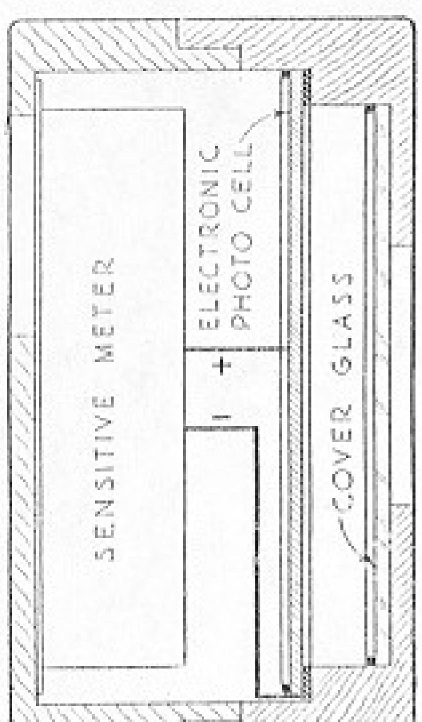
The film of silver should be very thin, and when gently polished the disk should have a silvery color with the red oxide slightly showing through. Contact is made to this surface with a metal ring (silver-plated copper, or lead) of slightly less diameter than the disk. It is advisable to give both the contact ring and the face of the disk a coat of thin lacquer, but do not allow the lacquer to come between the ring and the silvered surface and spoil the contact. The cell is housed in a turned wood box made as shown in Fig. 5.

In using the cell as a photometer, the sensitive meter and the electronic disk are housed in the same container, as shown in the drawing of the group of illustrations marked Fig. 6. The half of the box holding the cell is turned in steps, as in Fig. 5, in order that the disk may be set back from a light opening of smaller diameter. This is to limit the light entering the box so that only the light reflected from the scene to be photographed can affect the cell. One of the illustrations shows how an opening is cut in the other half of the box for the meter scale; hold the box on the saw table with the hands, and with the regular hold-down out of the way. Both the front of the photometer and the meter side are shown in Fig. 6.

A SPECIALLY calibrated scale must be attached over the regular meter scale. It can be accurately calibrated from an outdoor scene requiring a known exposure, such as 1/25 second at F/16. Train the cell side of the meter on such a scene, making a pencil mark on the scale where the pointer rests and marking it "16." Then take the meter indoors and train it on a large sheet of white cardboard illuminated with a photoflood lamp in a reflector. Move the lamp nearer or farther away from the cardboard, until the reflected light causes the meter pointer to rest at the pencil mark. By folding the cardboard in half, half as much light will be reflected and the pointer will rest at the next larger stop position. By using twice as much cardboard, the next smaller stop position will be indicated. In this way, pointer positions for each stop at 1/25 second can readily be found and marked on the scale. Stops for other speeds can be figured easily enough once the correct stop for 1/25 second is known.







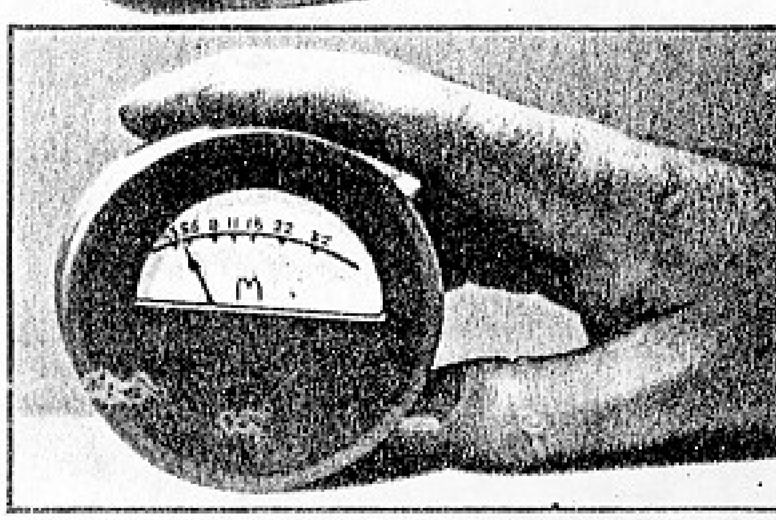
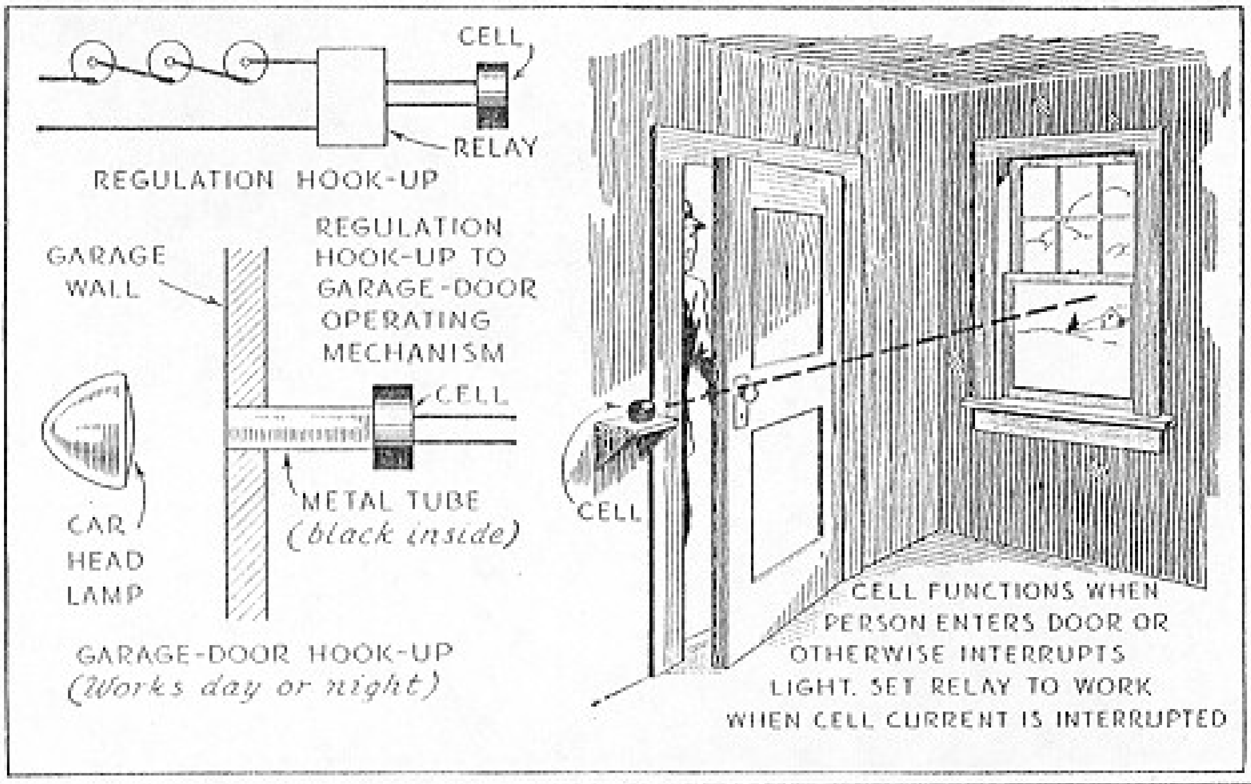


Fig. 6. A group of views of the photometer. The dial is calibrated to give the correct stop for a 1/25-second exposure



Popular Mechanics February 1958

Party Game Tests Eye and Hand Coordination

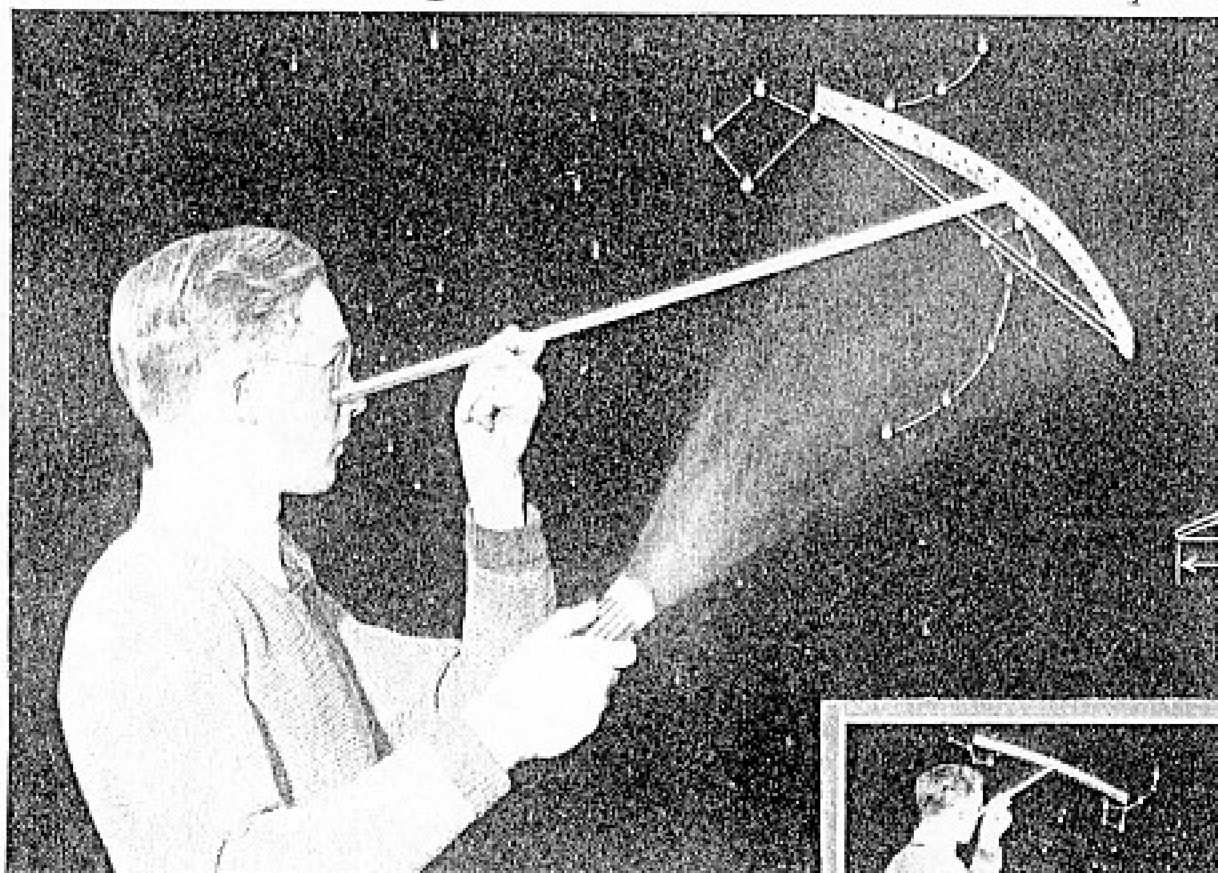
Introduce this interesting device at your next party and let your guests challenge each other as to who has the better coordination between hands and eyes. A small metal eye must be guided over a metal rod without touching it, the eye being just twice the diameter of the rod. The eye is bent on the end of a wire "wand" that is covered with rubber tubing to insulate it. A flexible wire is soldered to the end of the wand and run through a flashlight bulb, a dry cell and a switch to the horizontal rod over which the eye is passed. With this circuit, the bulb will light whenever the eye contacts the rod, which is bolted to a bracket that is screwed to a plywood base. If a doorbell or buzzer is used instead of a bulb, three dry cells will be required instead of just one.—E. R. Haan, Evanston, Ill.

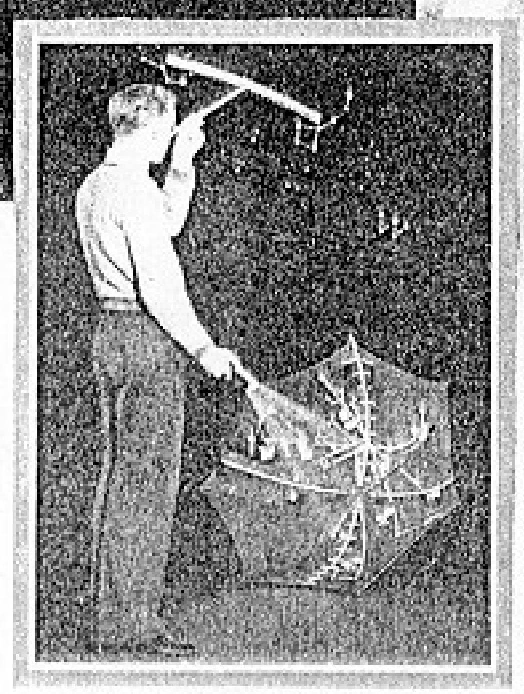
POPULAR SCIENCE MONTHLY
JUNE, 1933

How *to* Find the STARS *with a Crossbow*

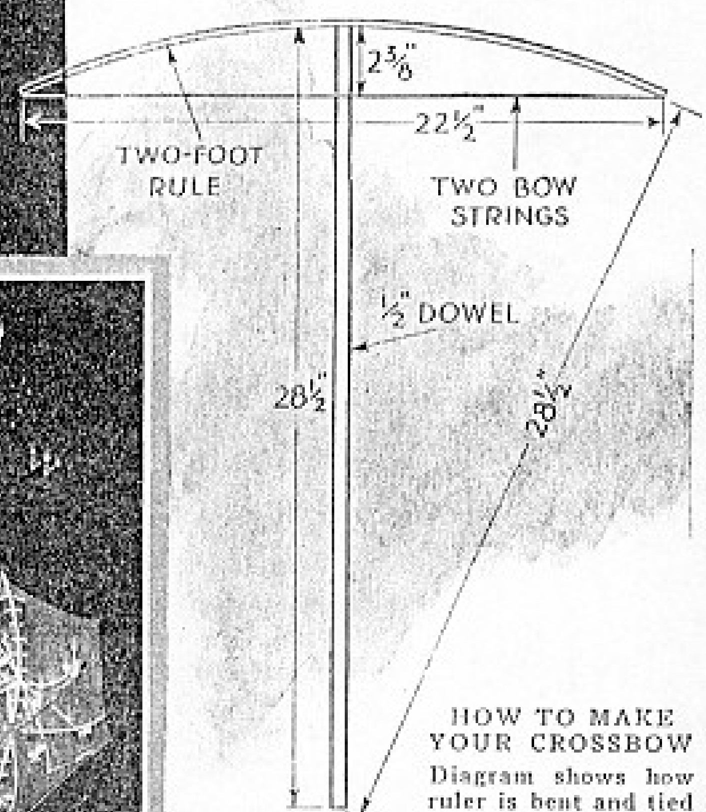
How You Can Find the Important Spring and Summer Star Groups in Northern Hemisphere

By GAYLORD JOHNSON





In using the crossbow, rest the bottom end of the stick on the cheek bone, place one end of the bow ruler on one of the stars and read off the point where the other star touches the ruler. Above, measuring the number of degrees between the bowl of the dipper and the Guards. Right, consulting umbrella map while sighting stars



HOW TO MAKE YOUR CROSSBOW
Diagram shows how ruler is bent and tied so that each part of it will be twenty-eight and a half inches from your eye when you use it

• Manner of Making a Simple Astronomical Instrument and a Perpetual Map of the Sky Is Explained in Detail in This Article for Amateurs

Any round object, like the penny above, held at fifty-seven times its diameter from the eye will occupy an angle of just exactly one degree

KNOWLEDGE of the principal star groups precedes any real pleasure in stargazing.

When you can recognize at a glance about two dozen groupings that contain important stars, you have learned the geography of the sky. You can then wander in skyland at will, and explain its points of interest to others. You can indicate the brightest of the sparkling suns and say, "There is Arcturus. There is Vega, and there are the Guards, the two stars that Columbus sailed by when he discovered the New World."

Knowing the stars by name, you will welcome the reappearance of characteristic spring star groups as heartily as you welcome budding trees and milder days. You will soon look upon these strangely imagined star animals and people as old familiar friends, that can always be found in their expected places.

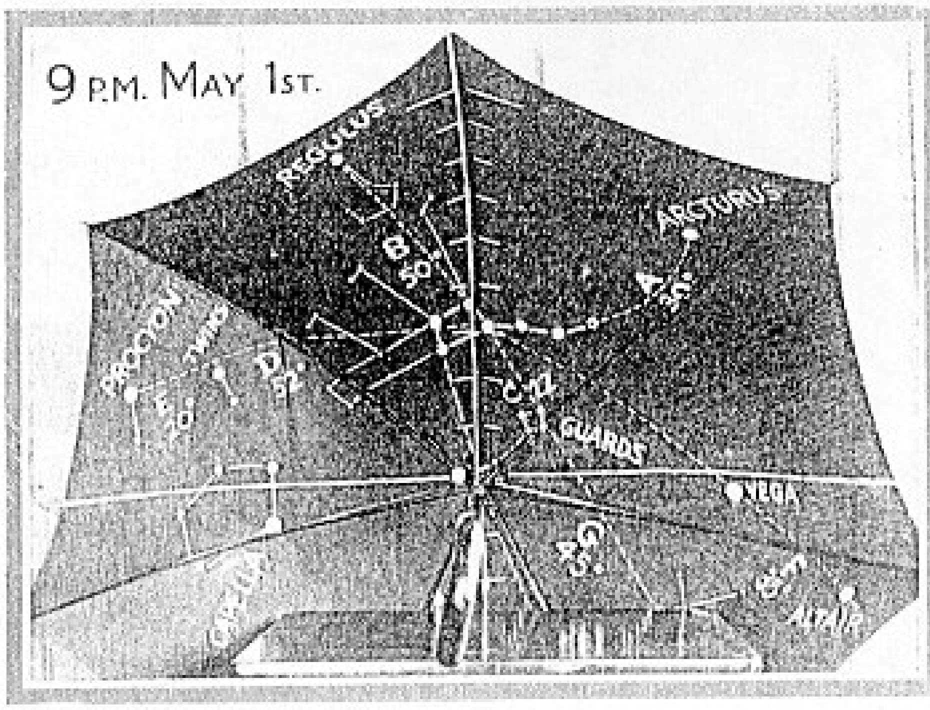
Nearly every one has at least two friends among the stars—the "big dipper" and the "polestar." In the last article I told how to tell time by following the twenty-four-hour rotation of the dipper around the pole. Now we shall start with the umbrella, on which you have chalked a few stars, and show the principal star groups that are visible at the different seasons. Then we shall invent a simple device that will enable us to find these stars at any time of the year.

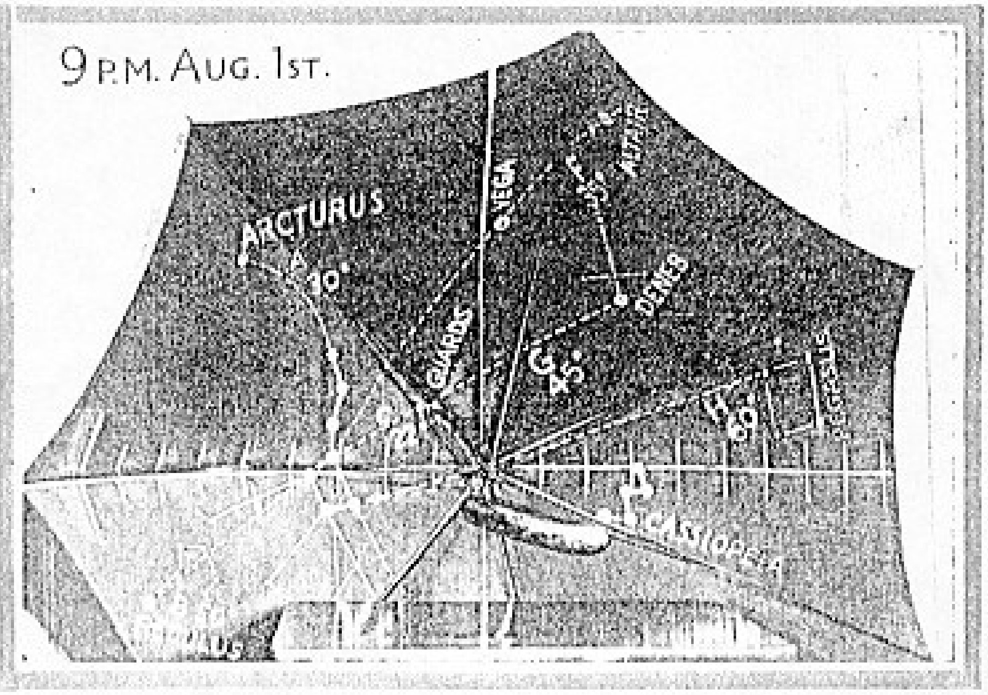
A glance at the two pictures of the umbrella shown makes it plain that the nine o'clock appearance of the northern sky changes from season to season.

Look closer and you will see that the big dipper rotates through a quarter turn around the polestar in three months. Also you will see that the four main groups around the polestar can be joined by two lines crossing at right angles.

A line from the dipper crosses the pole and meets a sprawling "W" or "M" about the same distance on the other side. This "W" group is Cassiopeia.

The other line, crossing the first at right angles, runs from a small group at the east of the pole, containing the single





A To find Arcturus, imagine the curving handle of the dipper to be made much longer. Place the end of the bow ruler on the last star in the handle, with the rule extended along the handle. At thirty degrees along the rule you will find Arcturus

B To find Regulus, in the Lion, hold the bow along a line joining the two stars on the side of the dipper next the handle. Place the end of the rule at the star where handle joins bowl. The ruler will point out a bright star fifty degrees from the dipper. This is Regulus

C To find the Guards, extend the line above the bowl of the dipper. Place the ruler along this line with end at star where handle joins bowl. Twenty-two degrees above the dipper are the sought-for Guards

D To find Castor and Pollux, extend the line of the dipper's handle through the star diagonally across the bowl. Hold end of ruler on this star and continue line fifty-two degrees at which point are twins

E To find Procyon, extend the line used to find Castor and Pollux twenty degrees beyond them to two main stars. The brighter is Procyon

F To find Altair, hold the ruler along a line from the star where the dipper's handle joins the bowl. At thirty-five degrees along this line beyond Vega you will find Altair

G To find Deneb, extend the line used in finding the Guards on beyond those stars. At forty-five degrees farther along you find Deneb

H To find Square of Pegasus, extend line from dipper's pointers to the polestar. At sixty degrees beyond the pole you find four bright stars and at their side is the Square

bright star, Vega, to a group of five west of the pole. The five form the constellation Auriga. The brightest of them is a brilliant yellow-white sun named Capella.

These four, one for each season, constitute our key groups. Using them as landmarks, we can find all the star groups at any time of the year, for some one of them is always in a good position from which to run lines that will help us find the other constellations of the season.

Notice in the illustrations that both the dipper and the W are cut by the third short white parallel line, counting from the pole. Each of the spaces between these short lines, extending along our umbrella's ribs from side to side, represents ten degrees. The dipper and the W are each therefore about thirty degrees from the pole. It takes six more divisions to reach the edge of the umbrella—ninety degrees in all from the pole of our miniature sky to its equator.

At this point you may ask, why can't we make a measuring rule, marked off in degrees, hold it up toward the real sky, and thus find all the other principal stars by their distance in degrees from the pole and from each other? We can. That is just what we are going to do, but first we must know the length of a degree.

Here is a simple rule that tells us exactly what we want to know: Any round object held at fifty-seven times its own diameter from the eye, occupies an angle of one degree. You can use a button, a coin, or a dinner plate.

Take a copper cent and measure its diameter. It is exactly three-fourths of an inch. How far must it be held from the eye to occupy an angle of one degree? Obviously, fifty-seven times three-fourths or forty-two and three-fourths inches.

To get a satisfactory measuring rod, hold a two-foot ruler at such a distance from the eye that each one-half inch division will occupy the angle of one degree. To do this the ruler must be held fifty-seven times one-half inch, or twenty-eight and one-half inches, from the eye.

If we do this with a *straight* ruler, however, it is obvious that the divisions at the ruler's ends will be more than twenty-eight and one-half inches from the eye. To correct this error we must bend the two-foot rule into a bow and fasten it by its center to a stick that is twenty-eight and one-half inches long. Then we shall be able to measure forty-eight one-half inch degrees in any direction on the curving bowl of the sky. With it, you can find the angular distance between any two stars, just as a ship captain does with his sextant.

To use your instrument, rest the bottom end of the stick upon the cheek bone below your eye, place one end of the bow ruler on one of the stars, and read off the point where the other star touches the ruler. The observer in the illustration is using his crossbow to measure the number of degrees between the star where the dipper's handle joins the bowl and the pair of stars called the Guards. With the end of the bow ruler at the star in the dipper, the Guards fall at a point about twenty-two degrees along the edge of the ruler. This corresponds to twenty-two half-inches or eleven inches on the curved bow ruler.

In making my instrument, I used an ordinary hardware store yardstick and a half-inch dowel rod. In order to see the divisions, when the bow ruler is held up against the sky, I notched its edge at two and one-half inch intervals. If I want a more precise measurement, I turn on a flashlight and note the exact half-inch division where the star touches the edge.

At nine p. m., about the first of May, the dipper is above the pole with Vega almost straight east of it. About the first of August, at the same hour, the dipper hangs down at the left of the pole, with Vega high above it.

During May, June, and July, Vega and the dipper are excellent finger posts for finding all the other principal stars of the early summer sky. Now with the aid of your crossbow you are ready to go out and find a few stars.

If you read over the series of six paragraphs, lettered A, B, C, etc., and look at the dotted lines lettered to correspond in the other illustrations, you will know exactly how to use your bow ruler in finding each star. Then, if you have chalked upon your umbrella the necessary lettered and numbered lines, you can take it out and use it as a memorandum of directions and distances, to be consulted with the aid of your flashlight.

It is easy to make a two-faced star chart that will show on one side the constellations in view in the Northern Hemisphere of the sky at a certain hour in the evening, and on the other side the groups to be seen at the same time south of the sky's equator.

To do this, take a piece of heavy cardboard thirteen inches square. Cut from its

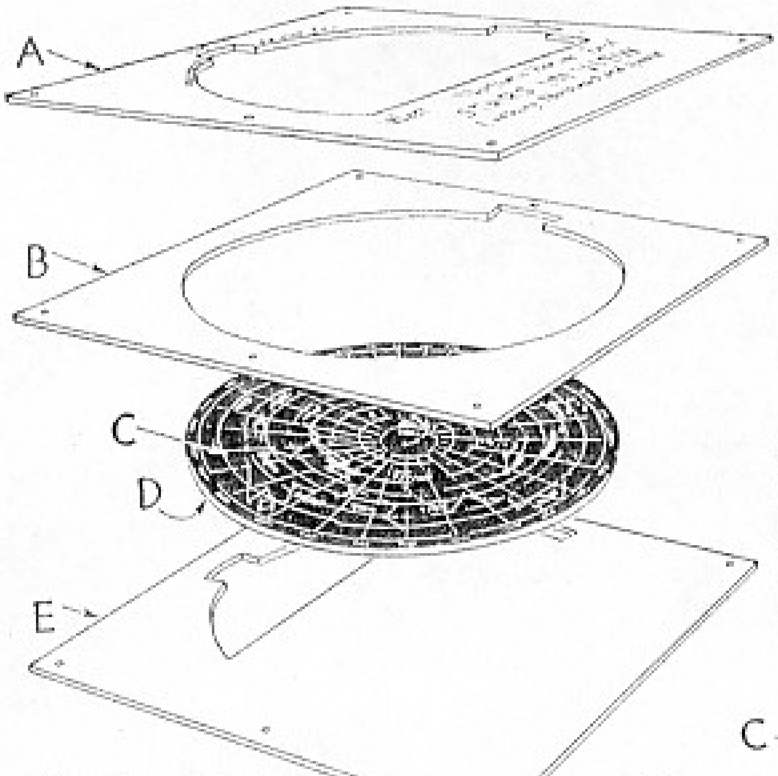
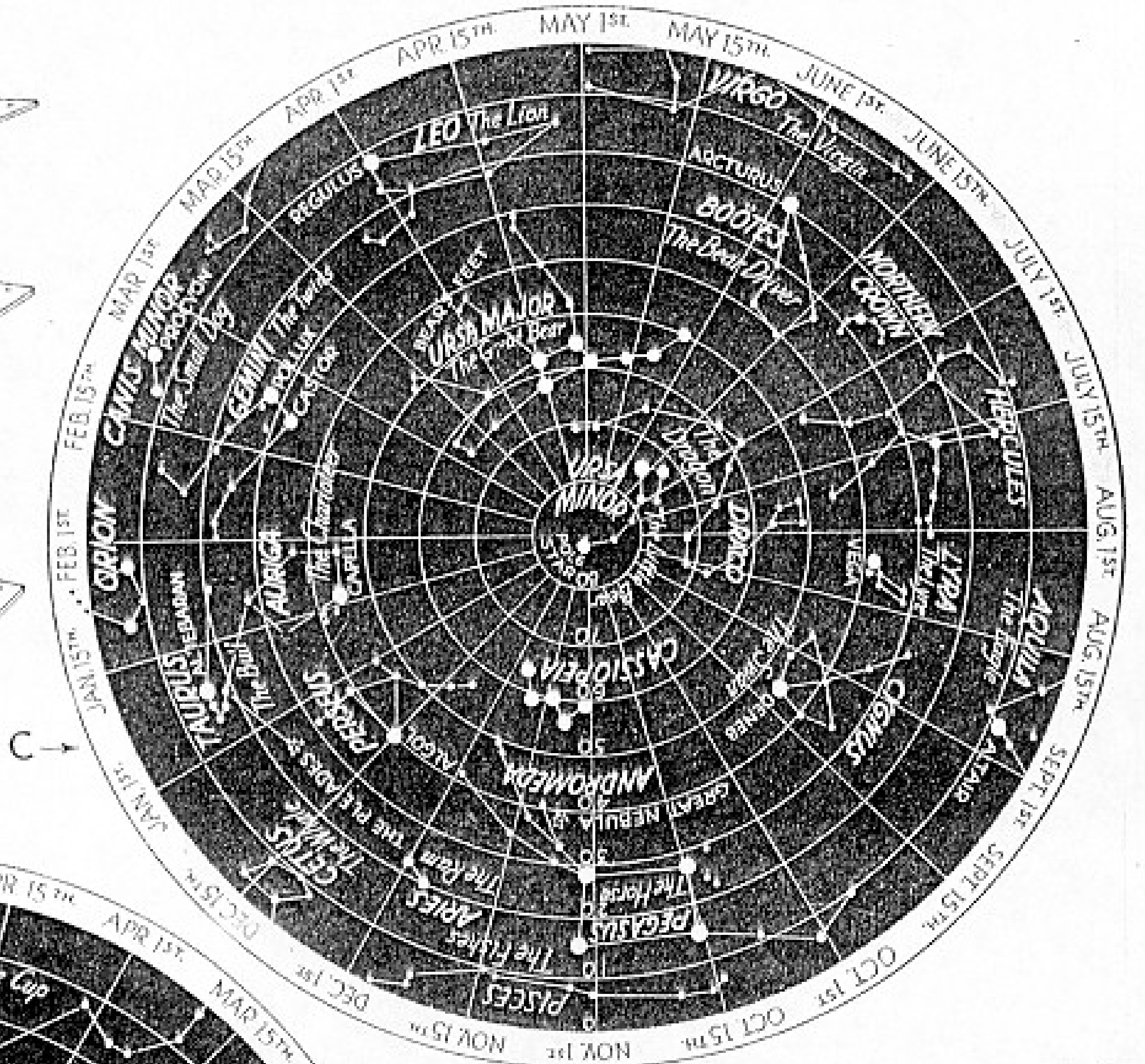
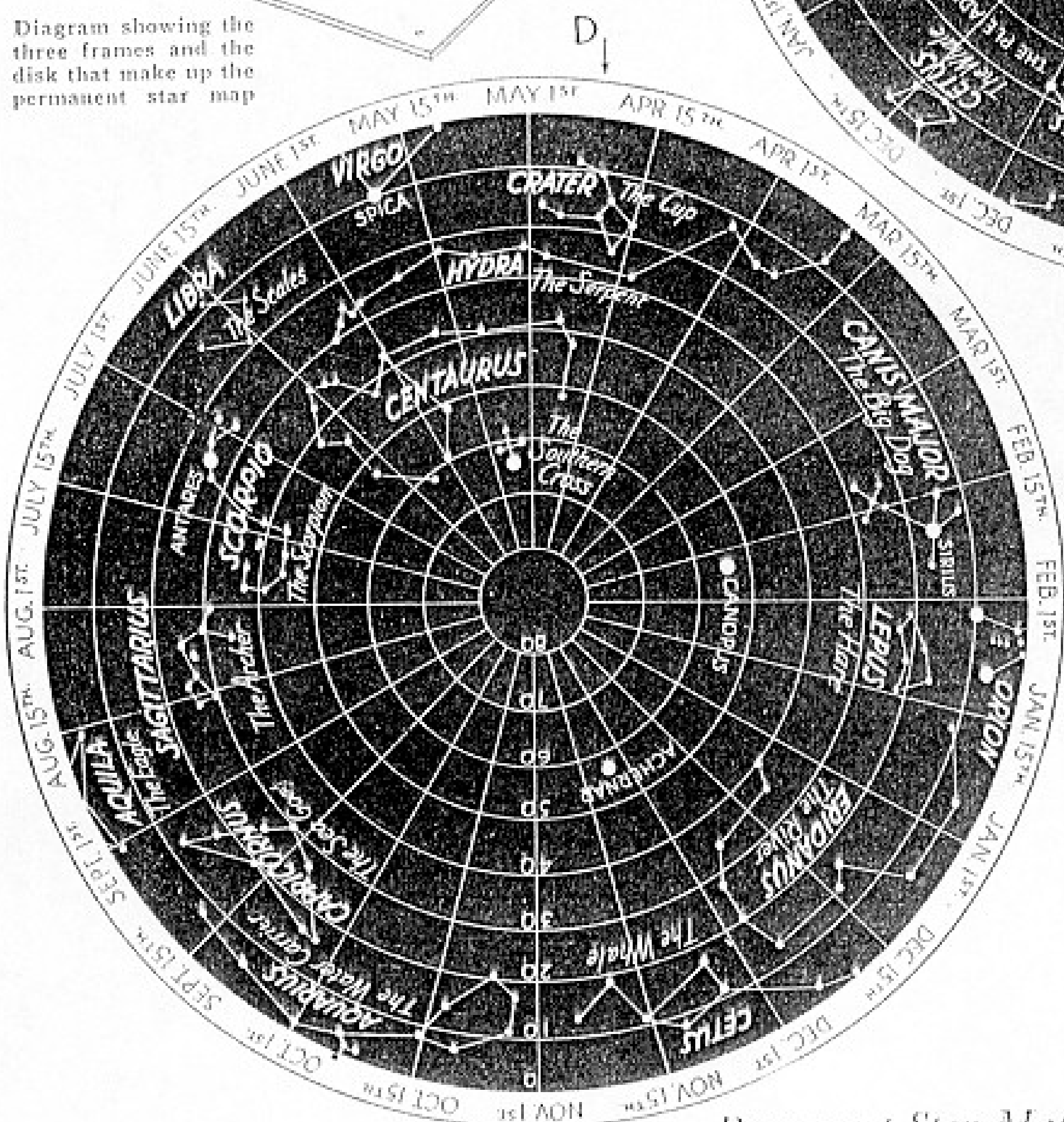
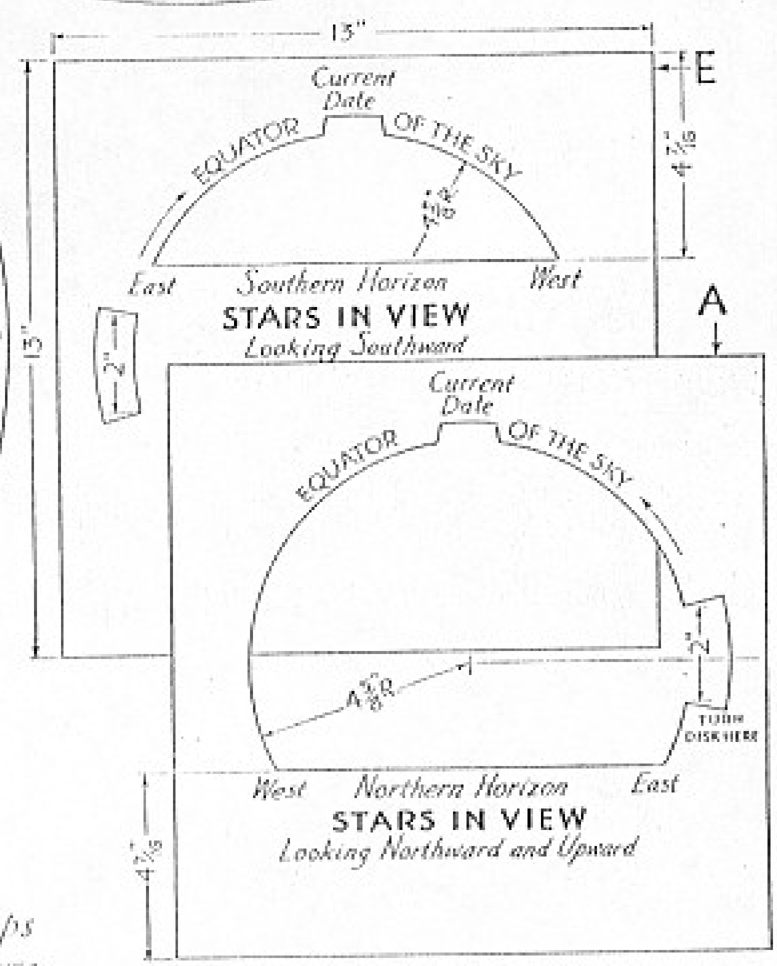


Diagram showing the three frames and the disk that make up the permanent star map







Permanent Star Maps of Principal Groupings

The diagrams above and at right show how to make a two-faced star chart containing on one side the stars of the Northern Hemisphere and on the other the stars south of the sky's equator. Complete directions for cutting the dial disk and frames and for accurately locating the stars on the charts are given on this page. Frames and disk can be cut from cardboard in the dimensions indicated, although a more durable map, of course, can be constructed of plywood, thick celluloid, or other like material center a perfectly circular piece ten inches in diameter.

Then, using a compass and straightedge, enlarge the circular plans shown on page 44 to nine and one-fourth inches in diameter, exclusive of lettering around edge. The radial lines are sixty degrees apart. Divide the radius into nine equal parts and describe concentric circles. It is then an easy matter to locate the stars and constellations on your charts by reference to the diagrams. The charts shown here were made on black paper with white ink, but black lettering on white paper is equally effective. If you live in a city and do not wish to go to the trouble of en-

larging the charts, you can take the page from this magazine to an office that makes photostat prints and have both plans enlarged to ten-inch circles for about a dollar. (See note on opposite page.)

When your two circular plans are enlarged glue them firmly to the two sides of the ten-inch disk. Make sure that the month names and their corresponding lines are exactly opposite. When the disk is complete, replace it in the hole from which it was cut. Sandpaper the edges.

From strong cardboard make the two square masks shown in the small drawings and glue them to the square frame of cardboard from which you cut the disk, with the curved sides of the mask openings toward the top. Glue the mask which has the larger opening over the face of the disk on which the big dipper and northern polar stars appear. The parts may also be fastened together with clips or rivets or by binding their edges with adhesive tape. Cut recesses at the top of the masks, as shown in the small drawings, so that the time of month will be visible on the disk containing the star charts; also cut openings at the sides of the masks and in center frame so you can turn the dial.

The two masks now hold the disk in place, yet allow it to revolve freely. As it turns, the fourth circles from the north and south poles should just touch the horizon lines. This applies to all places near the latitude of New York City, that is, forty degrees, north. In making the star map for a place ten degrees north of this, the mask opening having the northern horizon line must be extended downward until the horizon line touches the fifth circle below the north pole, but the bottom edge of the mask-opening having the southern horizon must be cut higher. It should just touch the fifth circle above the south pole of the sky. *Opposite* changes must be made for a place ten degrees south of the latitude of New York City.

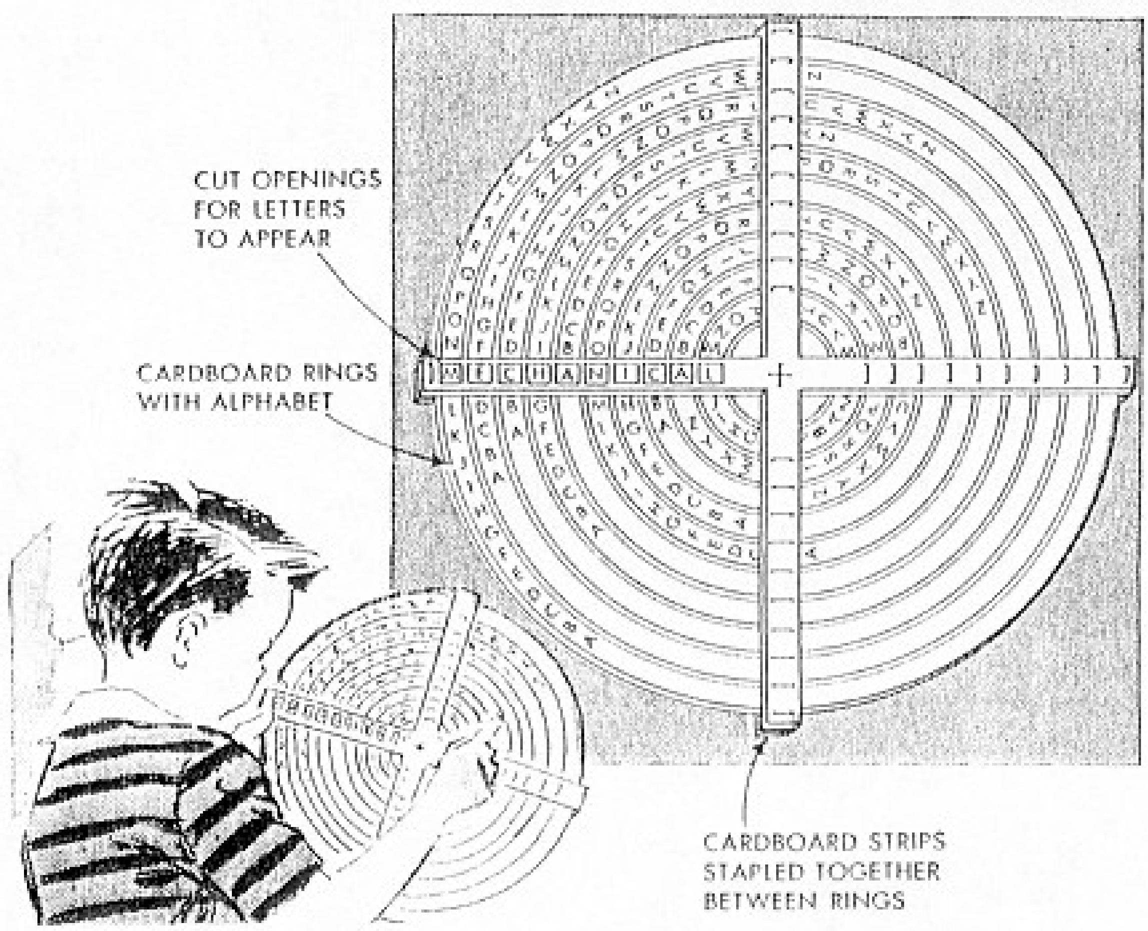
When your star chart is finished, turn the disk slowly with thumb and finger, and you will see the stars in view at nine o'clock at intervals of two weeks throughout the year. Note that we see more of the northern half of the sky than we do the southern. At the north pole we should see only the Northern Hemisphere, with the polestar straight overhead. At the equator we should see northern and southern halves of the sky equally, with the north polestar on the northern horizon, and the faint south polestar, Sigma Octantis, on the southern horizon. The belt of Orion, which is almost exactly on the equator of the sky, would then pass over our heads during winter nights.

Now that you have learned to know some of the sky countries by sight, you are ready to get your first thrills from seeing through a magnifying glass of moderate power some of their principal points of interest. The next article will give you the high spots of Opera Glass Astronomy. You will be surprised at how much you can see through a binocular magnifying ten times, or even through an opera glass magnifying three or four times.

The great Galileo proved his theories and revolutionized the accepted ideas of the universe with the aid of a rude telescope that was no more powerful than is one tube of a modern opera glass. As I have said in earlier articles, elaborate equipment is by no means essential to understanding and enjoying the grandeur of the heavens, nature's greatest show. Indeed, important discoveries in astronomy have been made with just the kind of simple equipment I have described.

Popular Mechanics September 1948

Amusing and Educating Spelling Game Provides Hours of Worthwhile Fun



Whether amusing himself alone or playing with other children, the youngster of school age will have hours of educational fun with this unusual spelling game. When the rings are rotated in the frame, letters of the alphabet printed on the rings appear in the windows cut in one of the cross members. The rings are cut from heavy cardboard and the frame, also of cardboard, consists of front and back strips stapled together in the form of a cross. The rings are held in place and spaced to align with the windows by inserting staples between them through the arms of the frame.—Opie Read, Jr., Chicago.

Continued from page 1907

in the atmosphere, and every water contains them after momentary contact with the air.

3. The development of these germs can not take place without the presence of phosphoric acid, or a phosphate, or phosphorus in some form of combination. Water, however much contaminated, if free from phosphorus, does not produce them.

EXPERIMENTS WITH COMPRESSED GUN-COTTON.

We have already given a notice of some remarkable experiments by Mr. Abel, of Woolwich, in regard to the effect produced by compressed gun-cotton, when simply laid on or pressed against the surface of bodies, and have mentioned various applications that have been suggested of this new explosive agent. A series of experiments has lately been made by the officers of the Royal Engineers, at Chatham, to determine more particularly the comparative effect of gun-cotton and gunpowder; and it was found that when two hundred pounds of gunpowder were laid against a double stockade of beams of timber fourteen inches square, three feet six inches apart, and sunk three feet in the earth, a large gap was made in the front stockade, while the second was but little damaged, and would have sufficed to prevent the passage of an attacking party. Eighty pounds of gun-cotton were next treated in the same manner, and fired, as required, by a detonating fuse. In this case the explosion was terrific, and an almost perfectly clear breach was made through both rows of timber, making it practicable for an attacking party to go through. In another experiment four beams of timber about sixteen inches square were sunk in the ground, pressed together, and encircled successively by necklaces of disks of the compressed gun-cotton. These were exploded, one after the other, and the beams were entirely cut in two. Other experiments of much interest were tried in the same connection, and all tended to prove the important applications of which the gun-cotton is capable.

ARSENIOUS ACID AND ALBUMEN.

The preservation of albumen for manufacturing purposes is a problem of much interest, in view of the great use of this substance in the arts, one method consisting in the addition of a slight amount of arsenious acid, or arsenite of soda. The use of the former is, however, sometimes inconvenient, on account of the great insolubility; and that of the latter is occasionally objectionable on account of its alkaline action affecting the application of the albumen. For the purpose of obviating these objections, Paraf suggested the boiling of the arsenious acid with glycerine, in which it is quite soluble; after allowing the solution to cool, and to stand for twenty-four hours, a few drops may be added to the albumen. The same substance can be added to gum-arabic, paste, and other substances, to prevent fermentation, putrefaction, and the development of fungi. It will, of course, be understood that arsenic in this preparation is highly poisonous, and its use with substances intended to be eaten is, therefore, out of the question.

ORGANIC EFFECT OF DIFFERENTLY COLORED LIGHT.

According to M. Pouchet, certain rays of light are particularly favorable to the development in organic infusions of infusorial life, while other rays are most favorable to the growth of microscopic forms of a vegetable

What is a Survivalist?

by Kurt Saxon

When a person embarks on a course of action, whether it be a profession, hobby, belief, or whatever, a label is needed. Some people don't like labels but they are necessary for advertising and identification.

The term "Survivalist" is fast becoming a household word. It is mentioned constantly on television, in newspapers, magazines and radio. Although just about everyone has come across it, few really know what it means. The term evolved from the general phrase "back to the lander". That was used mainly by ecologists and conservationists alarmed at the growing pollution affecting the quality of life.

The January 1970 issue of MOTHER EARTH NEWS printed a comment by Gary Snyder on pollution. "The human race for the last century has allowed it's production and dissemination of wastes, by-products and various chemical substances to become excessive. Pollution is directly harming the eco-system. It is also ruining the environment in every direct way for humanity itself."

In the same issue, reprinting from CAVALIER, an article titled "How to Make It Your Way," they suggested escaping to communes. "So the air is full of crud and the water tastes funny and the nine-to-five is a drag. You're tired of the subway, dog crap in the streets, bumper-to-bumper traffic and plastic TV dinners. Maybe the communes — with all that fresh air, sunshine, love and home-baked bread — are really into something."

The communes didn't work out very well. There was an overall likemindedness but the lack of discipline and practical skills doomed most such projects from the start. Also, too many who joined communes simply wanted a secure refuge where they could smoke their dope in peace.

The MOTHER EARTH NEWS had a great impact on the Urban Dropout movement from the time of it's first publication in January 1970. They made millions aware of the possibility of finding a more pleasant environment and creating a more secure and fulfilling lifestyle.

In the early '70's Don Stevens, who sells books on self-sufficiency out of Washington state, popularized the term "retreater." The term obviously indicated one who had prepared a retreat in the boondocks to go to when city living became intolerable.

There is nothing wrong with the term "retreater" when used in it's proper context. But it is a buzz word to certain types. I just heard what might have been a joke about a general who had an auto accident because he ignored a "Yield" sign. "Yield" was a buzz word to him.

"Retreater" was acceptable to pacifist drop-outs of the MOTHER EARTH NEWS school of thought. But to the more aggressive person it had strong connotations of cowardice.

I certainly didn't like it, since my scenario of the near future calls for aggressive measures to protect mine from all comers. A poem says "I'll build my house by the side of the road and watch the rest of the world go by." That attitude is fine for "retreaters" but what happens when part of the world turns in to loot that house by the side of the road?

The pacifist drop-outs and other non-involved persons simply leave the cities with no fanfare. They don't feel the need for a label because their move is not any form of protest. Also, they don't seem aware that the people they

The pacifist drop-outs and other non-involved persons simply leave the cities with no fanfare. They don't feel the need for a label because their move is not any form of protest. Also, they don't seem aware that the people they simply don't care to live near may well be a danger to them in the future as marauders.

Unlike the back-to-the-landers, the ecologists, the retreaters and such, survivalists are not non-involved pacifists. They are not necessarily eager to kill, either. They are simply aware that civilization is cracking up and see the possi-

character. Thus, white light is said to be best fitted for the former result; after which comes the red ray, then the violet, the blue, and finally the green. On the contrary, for the development of vegetable organisms the green ray is best fitted; next to this the blue and violet, and lastly the white light; the red ray hindering the development of these organisms. An experiment of a similar character has recently been made by Mr. Wake in regard to the effect of differently colored light upon milk; and he informs us that the general result of his experiments with this substance corresponds with those mentioned by M. Pouchet. According to his statements, the fungoid filaments of the milky infusion exposed to the green light were larger than those of the other infusions, while the tendency to the formation of these filaments under the influence of yellow light was but feebly exhibited, although *Bacteria* were very plentiful.

UTILIZATION OF SCRAPS OF TINNED IRON.

The method of utilizing scraps of tinned iron, devised by Dr. Adolph Ott, is said to answer an excellent purpose, and to be in successful operation in various German tin-plate establishments in New York. For the purpose in question the scraps are placed in large perforated copper vessels, and rotated from thirty to forty minutes in a tank containing warm hydrochloric acid, when the tin, lead, and about five per cent. of iron will be dissolved. The copper drum is then lifted from the acid into a vessel of water, then into one of alkali, and again into water, when the scrap will be found free from tin, and may be sent to the puddling furnace.

The lead may be separated from the solution by the addition of sulphuric acid, and the tin may be obtained in the metallic state by immersing plates of zinc in the liquid. Thus regained, it requires only washing in water to be ready for melting and casting into blocks.

The solution left behind after the separation of the tin, containing chiefly chloride of zinc and iron, is said to be found serviceable in preserving timber by impregnation.

IMMUNITY OF THE PIG FROM INJURY BY SERPENT BITES.

The impression is generally prevalent in the United States that the common domestic pig is an especial enemy of all kinds of serpents, and that it is capable of receiving the bite of the rattlesnake and copper-head without the slightest personal inconvenience or injury. This same immunity from harm would seem to exist in other countries, as a late writer in the London *Field* remarks upon the fondness of the pigs in India for the cobra de capello, and states that he has repeatedly seen them in conflict, and has observed the pig to be bitten over and over again in the snout and about the face by the writhing reptile, and in no instance with the slightest ill result to the aggressor.

CHEAP SUBSTITUTE FOR DOUBLE WINDOWS.

It is suggested by Dr. Oidtmann, in a pamphlet on the care of health, simply to add a second set of panes of glass, set in an inner rabbet, to a single sash, and thus inclose a stratum of dry air, about 0.2 to 0.4 of an inch thick. The excess of cost, it is said, will be more than covered by the economy of fuel in winter; and at 90°, in summer, a room thus protected will remain nine degrees cooler than when supplied with ordinary windows. The plan is also advantageous for hot-beds, etc. A good hard quality of glass, that does not become dull by decomposition, must be selected, especially for a southern exposure, since the interior faces can not be cleaned. It is necessary also not only that the glass

ble need for desperate measures to come through with a whole skin.

The social unrest of the '60's gave a great but delayed impetus to the Survivalist movement. As discontent manifested in urban rioting, clashes between militant rightists and leftists, assassinations, etc., the government threatened gun confiscation.

Millions grew afraid of their government and felt trapped and helpeless. As their children were bussed to black neighborhoods, as their streets became increasingly dangerous and the quality of life lowered, they began wanting out.

The weapons oriented magazines urged protest on all levels. They also detailed to their readers the government threats as well as the overall urban dissolution.

Some of them used the term "retreater" when suggesting that their readers drop out. But gun-oriented types were more likely to sit tight than leave under the stigma of "retreater." I am not suggesting that anyone put off leaving because of the term. It is just that they took a militant stand rather than retreat.

In late 1975 when starting THE SURVIVOR, I coined the term "Survivalist" and used it in the first issue published in January of 1976. In THE SURVIVOR I have been urging decent people to abandon urban blight and take their loved ones to a safer environment.

My term has been catching on and now those offended by "retreater" are quite satisfied to call themselves Survivalists and move out. It has turned out to be a word anyone can accept as a label if they want one.

Even so, the media is generally down or urban dropouts so they have been giving Survivalists a bad name. As you know, the media is part and parcel of the Urban Establishment. It follows that anyone unwilling to stay in the cities and support the Establishment and it's hordes of dependents is some kind of a kook.

A while back, Boyd Matson, of the TODAY SHOW called with the idea of interviewing me. When he found I didn't wear a camouflage jacket, a beret and carry a burp gun he backed off.

Some time later I saw the segment he made to describe Survivalists. There was a flock of about a dozen turkeys wearing camouflage jackets and drilling with rifles in the Oregon woods.

I didn't know them but I could tell they were urban clerical types fantasizing playing soldier. They said they had a cache of food and weapons they would go to when the collapse came. In the event that they could get to their cache they would find that roughing it might be a little harder than they thought. Also, with such a Mickey Mouse setup they would run out of supplies in no time. Then they would turn into the same kind of predators they claimed to be armed against.

Do not be surprised when you see Survivalists portrayed as idiots and fear-crazed kooks. The sorriest was the Lou Grant segment titled "The Survivalists." They had a nut in that show who, during a California flood, stole a roll of plastic at gunpoint. He had his kids armed and waving their weapons at anyone who came around. He also used a phrase from one of my editorials, "Those who plan to survive deserve to survive."

So they had my material and used it to make Survivalists look stupid and dangerous. They don't all do that but don't be disturbed when you see such depictions.

Although everybody uses it today, I figure since I made it up I can also make up it's definition. I certainly didn't mean it to be used to describe predators.

My definition of a Survivalist is a self-reliant person who trusts himself and his abilities more than he trusts the Establishment. Insofar as the Establishment is deteriorating, the Survivalist prepares to leave it.

There are some who call themselves Urban Survivalists but I consider that a contradiction in terms. To hole up in an apartment and expect to survive mobs of starving rioters is silly. Imagine utilities cut off or blown up. Add police and National Guardsmen fighting urban guerrillas, firemen letting whole blocks burn and all exits being cut off.

should be perfectly polished, and not be soiled in putting it in, but, since the air inclosed ought to be dry, the glazing should be done when the air is in the best condition in that respect. Ice crystals, of course, never form on such windows.

AIR-CUSHION FOR THE FEET IN RAILWAY TRAVEL.

A writer in the *Medical Times and Gazette* refers to the fatigue of the limbs produced after a long railway journey as due mainly to the trembling motion of the floor under the feet, and states that, having suffered considerably from this cause, he was induced to try the experiment of using the well-known air-cushion as a foot-stool. This answered so well that he has never traveled without using one in this way, and has found the effect to be a remarkable improvement.

GREEN COLOR IN PICKLES.

It is said that to impart an excellent green color to pickles they must be first covered with boiling hot salt-water, and after a short time the water poured off and the pickles drained. They are then to be placed in an earthen pot and covered with boiling vinegar, the top put on, and the whole kept at a lukewarm temperature for a long time, the vinegar being poured off every day, heated to boiling, and turned again upon the pickles. This is to be continued until the color is a beautiful green. The vinegar used in this process is then to be poured off and replaced by fresh, and the jar closed tightly. This method of coloring is perfectly harmless, although the result is as bright a green as that of verdigris.

PHYSIOLOGICAL ACTION OF ACONITE.

Messrs. Gréhaut and Duquesnel have been lately prosecuting some inquiries into the physiological action of *aconitine*. Among other experiments, they injected one-twentieth of a milligram under the skin of the back of a frog. Thirty minutes afterward the sciatic nerve had completely lost its motoricity, though the muscles of the thigh contracted when stimulated by an induced current, and the heart beat regularly. In another experiment one leg of the frog was tied so as to arrest circulation, and the frog then poisoned with aconitine. All the motor nerves which received the poisoned blood lost their physiological properties, while those of the preserved limb remained excitable.

From these results it appears that small doses of aconitine are analogous in physiological results to curarine in destroying the motor power of the nerves. A dose of one milligram of aconitine, however, injected into a frog (twenty times as much as that used in the first experiment) completely arrested the action of the ventricles of the heart, the auricles alone contracting feebly; the excitability of the motor nerves continued for a long time in this case, and the animal continually moved, spontaneously or convulsively. By microscopic examination of another frog similarly treated, it was found that in one minute and a half the arterial circulation was much slackened, and in three minutes had completely ceased; the nerves did not lose their motoricity, because, through the cessation of circulation, they did not come in contact with the poison.

In mammalia the effects of the poison show themselves more rapidly, and are more difficult to analyze; a milligram of aconitine injected into a rabbit in which artificial respiration was kept up was found, after half an hour, to prevent the sciatic nerve from producing contraction of the muscles, although these had preserved their contractility.

MIND IN LOWER ANIMALS.

Dr. Lander Lindsay, in an essay just published, which has excited some attention, takes the ground that the mind of the lower animals does not differ in kind from that of man, and that they possess the same affections, virtues, moral sense, and capacity for education, and are liable to the same kinds of mental disorders.

A real Survivalist would move out of the urban area to a small town while there is still time. I can't see how a Survivalist could live in a city in the first place.

So if you consider yourself a Survivalist and want to tell your unborn grandchildren about it, get out of the city. Move to a small town and become part of the community.

When the worst is over you might have seen some turmoil and even driven away some urban marauders. But you and yours will survive with dignity and with no regrets. That is what a real Survivalist is.

Continued on page 1919

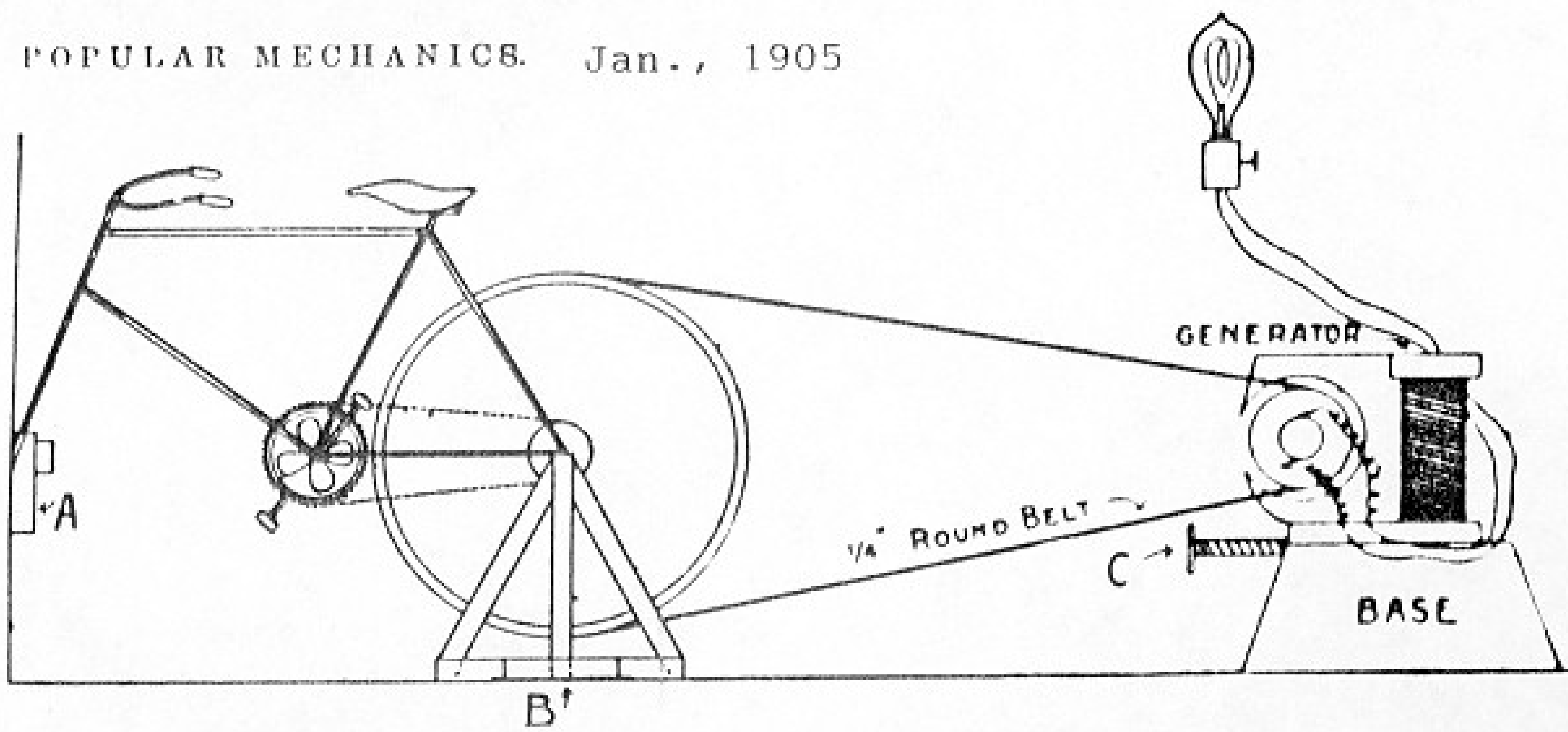
CYCLE.

One of our readers, W. J. Slattery, of Emsworth, Pa., uses an old bicycle for running a small 10-volt generator; he says:

"The front forks of the wheel are securely braced to the wall and the back forks are then braced up so as to have the back wheel clear the floor about 3 in. The generator is set 5 or 6 ft. distant. To keep the belt tight a sliding brace can be made and worked by a screw.

"I have one of these rigged up and it is just the thing for charging small storage batteries, running small motor and for all experimental purposes where light power is required for a short time."

POPULAR MECHANICS. Jan., 1905



Running a 10-Volt Generator with a Bicycle

How to Build a Wind Vane with an Electric Indicator

Popular Mechanics — 1915

Quite often it is practically impossible to ascertain the direction of the wind by observing an ordinary wind vane on account of the necessity of locating the vane at such a height that it may give a true indication. By means of the device shown in Fig. 2, the position of the vane may be determined without actually looking at the vane itself and the indicating device may be located almost anywhere and independently of the position of the wind vane.

The principle upon which the device operates is that of the Wheatstone bridge. The position of the moving contact A, Fig. 1, is controlled by the wind vane. This contact is made to move over a specially constructed resistance R, Fig. 2. A second movable contact, B, is controlled by the observer and moves over a second resistance, identical with that over which the contact A moves. These two resistances are connected so as to form the two main branches of a Wheatstone bridge; the points A and B are connected to the current-detecting device, which may be a galvanometer or telephone receiver, and current is supplied by a number of dry cells.

In order to obtain a balance—that is, no current through the receiver—the points A and B must occupy corresponding positions on their respective resistances. If the two resistances over which the points A and B move are mounted in the same position with respect to the cardinal points of the compass, then the points themselves will always be in the same position with respect to the cardinal points when a balance is obtained. The arrow head on the wind vane and the point A are made to occupy corresponding positions, and hence the position of the point B, when no current passes through the receiver, is an indication of the direction in which the wind vane is pointing.

The principal parts in the construction of the device are shown in the illustration, and the following description of their construction may be of interest to those who contemplate building the indicator.

Procure two pieces of $\frac{1}{16}$-in. hard rubber, 1½ in. wide by 24 in. long. Clamp these, side by side, between two boards and smooth down their edges and ends, and then file small slots in the edges with the edge of a three-cornered file. These slots should all be equally spaced about $\frac{3}{32}$ in. apart. Have the pieces clamped together

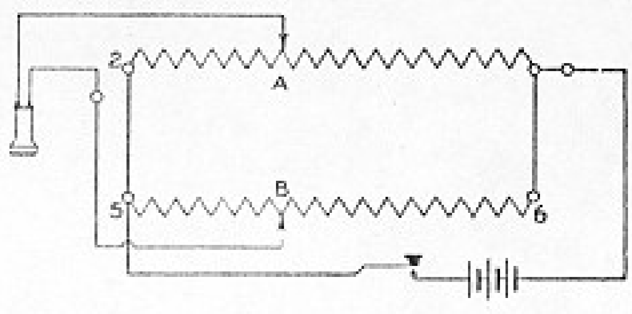


Fig. 1—The Diagram of a Wheatstone Bridge Which Shows the Points of Contact So Placed That a Balance is Obtained

while filing the slots and mark one edge top and one end right so that the pieces may be mounted alike. Now procure a small quantity of No. 20 gauge bare manganin wire. Fasten one end of this wire to one end of the pieces of rubber by winding it in and out through three or four small holes and then wind it around the piece, placing the various turns in the small slots that were filed in the edges. After completing the winding, fasten the end just as the starting end was attached. Wind the second piece of rubber in a similar manner and make sure to have the length of the free ends in each case the same. Obtain a cylinder of some kind, about 8 in. in diameter, warm the pieces of rubber by dipping them in hot water, bend them around the cylinder and allow them to cool.

A containing case, similar to that shown in cross section in the upper portion of Fig. 2 should now be constructed from a good quality of tin or copper. The inside diameter of this case should be about 1 in. more than the outside diameter of the resistance ring R, and it should be about 3 in. deep. The top C may be made curved as shown in the illustration, and should be fastened to the case proper by a number of small machine screws. The base of this case may be made so that the whole device can be mounted on the top of a pole.

Mount a piece of ¼-in. steel rod, about ½ in. long, with a conical hole in one end, in the center of the bottom of the case as shown by M. A number of supports, similar to the one shown, should be made from some ¼-in. hard rubber and fastened to the sides of the case, to support the resistance ring. The dimensions of these supports should be such that the ends of the piece of rubber, forming the ring, are against each other when it is in place. The upper edge of the ring should be about 2 in. above the bottom of the case.

Next, mount a piece of brass tube,

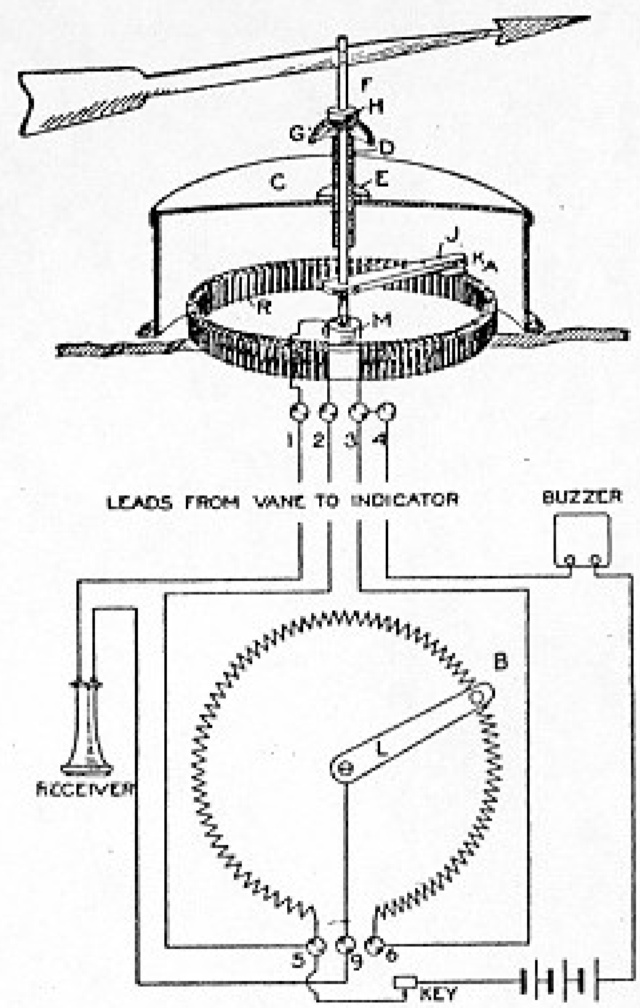


Fig. 2—The Weather Vane with Resistance Coil, and Diagram of Indicator Which is Identical with That of the Vane

D, in the exact center of the top and perpendicular to it. A washer, E, may also be soldered to the top so as to aid in holding the tube. Procure a piece of steel rod, F, that will fit in the tube D and turn freely. Sharpen one end of this rod and mount a brass wind vane on the other end. A small metal cup, G, may be soldered to a washer, H, and the whole mounted on the steel rod F in an inverted position as shown, which will prevent water from getting down inside the case along the rod. The cup G may be soldered directly to the rod. Make a small arm, J, of brass, and fasten a piece of light spring, K, to one side of it, near the outer end, then mount the arm on the steel rod so that it is parallel to the vane and its outer end points in the same direction as the arrow on the vane. The free end of the light spring on the arm J should be broad enough to bridge the gap between adjacent turns of wire on the resistance ring. Four bindings should then be mounted on the inside of the case and all insulated from it with the exception of number 1. Numbers 2 and 3 are connected to the ends of the winding and number 4 is connected to number 3.

A second outfit should now be constructed, identical with the one just described except that it should have a flat top with a circular scale mounted on it, and the arm L should be con-

trolled by a small handle in the center of the scale. The position of the contact B may be indicated on the scale by a slender pointer, attached to the handle controlling the arm L.

Four leads of equal resistance should be used in connecting the two devices and the connections made as shown. An ordinary buzzer placed in the battery circuit will produce an interrupted current through the bridge circuit and a balance will be obtained by adjusting the contact point B until a minimum hum is heard in the telephone receiver.

Continued from page 1917

NITRITE OF AMYL.

Among the recent additions to the *materia medica* which promise to be of value in the treatment of disease, one of the most interesting is the nitrite of amyl, one of the numerous products of coal-tar. If four or five drops of this substance be sprinkled on a handkerchief and inhaled, a sensation of great fullness of the head is experienced, accompanied by a pricking of the skin and redness of the face and ears, and if continued for any considerable time, consciousness is lost for a season. It is said, however, that this application will prevent a threatened attack of an epileptic fit, if the patient is sufficiently aware of its approach to apply the remedy in time. It is also asserted to be very serviceable in preventing attacks of asthma consequent upon heart-disease, and even of angina pectoris, stopping both at once, and possibly tending to reduce the violence and frequency of the attacks.

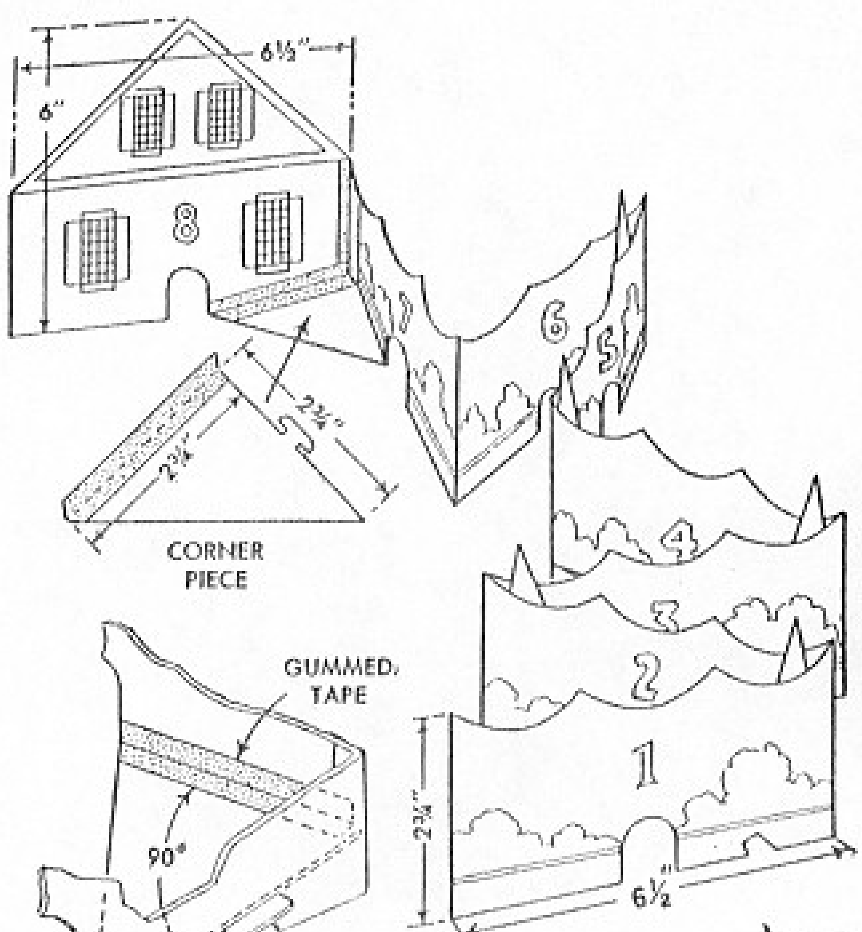
Its secondary effects are considered not at all injurious, and the dose of four drops is said to be perfectly safe.

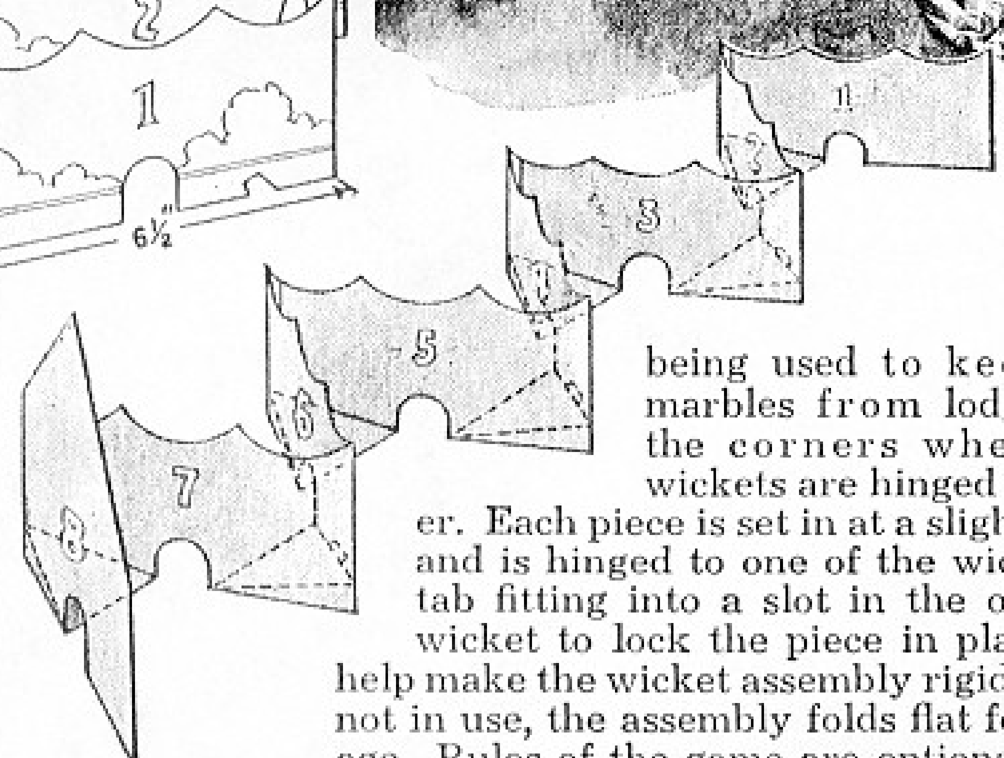
HYDROBROMATE OF CODEIA, ETC.

Few substances of the vegetable kingdom furnish so extensive a field for investigation as opium, and we seem even yet to be far from having determined all its simple constituents, to say nothing of the combinations which these are capable of forming with one class of bodies or another. In the course of an elaborate inquiry by Dr. Wright upon the action of hydrochloric and hydrobromic acids upon codeia and morphine, two of these opium bodies, it was ascertained

Continued on page 1922

Marble "Croquet" Is Interesting Indoor Game





Children and adults alike will enjoy this novel marble game, which can be played on any flat surface such as a floor or table top. The game is somewhat like croquet, the object being to shoot a marble through eight cardboard wickets, the winner being the one who accomplishes this in the least number of plays. The wickets are pieces of cardboard hinged together with tape as indicated. Each wicket has a centralized hole at the lower side, triangular pieces of cardboard being used to keep the marbles from lodging in the corners where the wickets are hinged together. Each piece is set in at a slight angle and is hinged to one of the wickets, a tab fitting into a slot in the opposite wicket to lock the piece in place and help make the wicket assembly rigid. When not in use, the assembly folds flat for storage. Rules of the game are optional. One shot in turn is the prevailing rule. If an opponent's play causes your marble to pass through a hole, your position is advanced or penalized accordingly, and your next play is resumed from that point.

R. L. Ralston, Jackson, Mich.

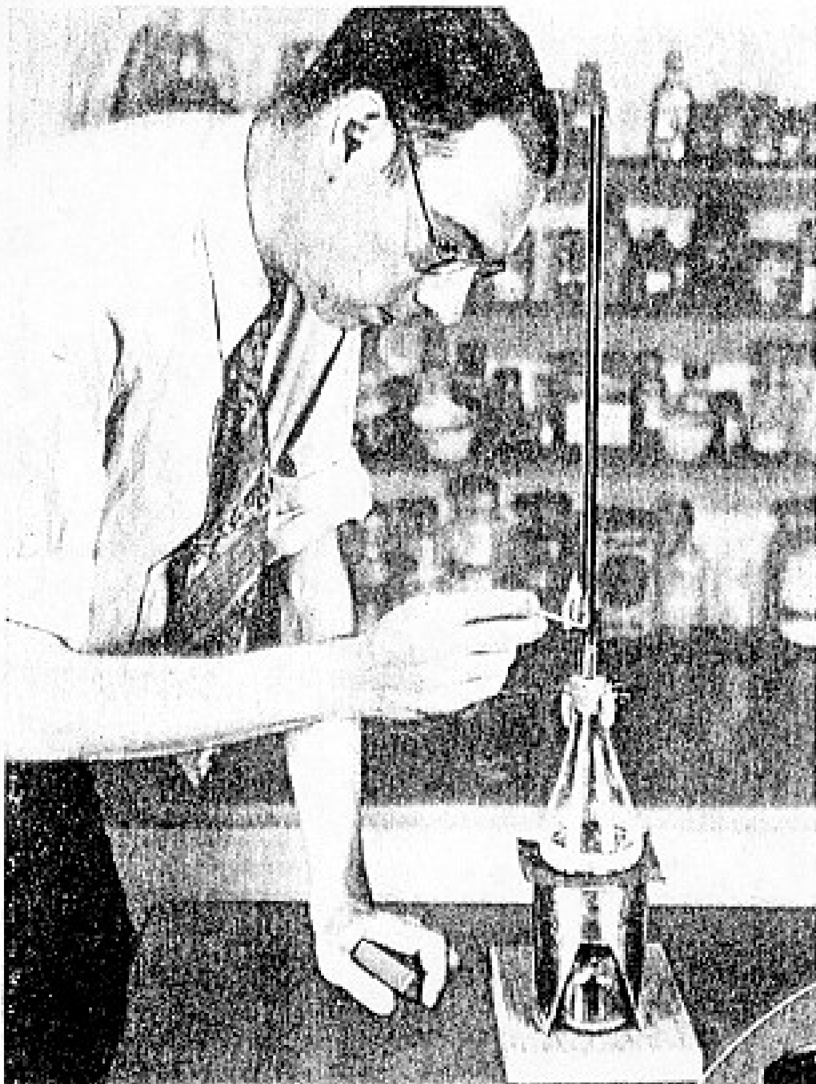
Popular Mechanics Oct. 1945

Bottles, Tubes, and Other Objects Found in Every Household Can Be Made into Apparatus For Performing Many Fascinating Experiments

By Raymond B. Wailes

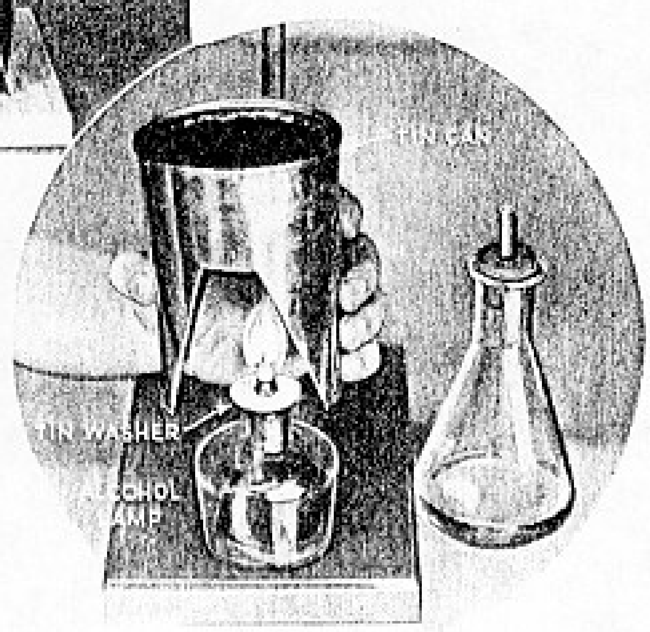
POPULAR SCIENCE MONTHLY FEBRUARY, 1936

Chemistry Equipment from Odds and Ends



PROOF THAT AMMONIA GAS WILL BURN

When a solution of ammonium hydroxide is heated gently in a flask, ammonia gas is released. A lighted match held to the outlet of the flask ignites the gas as it breaks down into nitrogen and hydrogen, the latter burning. The heater illustrated is an alcohol lamp fitted with a shield made from a can, as shown below



"I WISH I had a chemical laboratory, but I can't afford it," more than one would-be home experimenter has told me. They share the popular idea that chemistry is necessarily an expensive hobby.

It needn't be. Naturally, it is sensible to enjoy the convenience of the fine equipment that supply houses can provide, if you have the money to spend for it. You might be surprised, however, if your purse is limited, to discover how much of the apparatus you need can be assembled at little or no cost from odds and ends. Perhaps it may not be as professional-looking as some that you have seen, but it works, and that is the main thing you are interested in. Later on, if your finances allow you to add more costly pieces of ready-made equipment, the experience you have already had with inexpensive homemade apparatus will guide you in making wise selections.

Your own home will yield a variety of objects that can readily be transformed into useful laboratory accessories. Bottles of every description are treasure trove, for they may be cut apart, by methods described in previous articles of this series, and used to make all sorts of apparatus—funnels, crystallizing dishes, pneumatic troughs, condensers, drying tubes or towers, and reaction chambers. Discarded or broken glass "straws," the kind used for sipping beverages, make useful tubes for conducting liquids and gases. Corks of all kinds, and odd lengths of rubber tubing, are worth-while finds for an amateur chemist ransacking the household cupboards. Even unlikely looking objects are not to be passed over too hurriedly—a pair of letter scales, for example, may come in handy for weighing out chemicals.

To store your supply of chemicals, you will need an array of small, neatly labeled vials or bottles. Wide-mouthed bottles should be used for solids, and small mayonnaise jars will serve the purpose. Wash the inner lining of waxed cardboard, under the metal cap; but do not discard it, for many chemicals would attack the bare metal. Small-mouthed bottles are preferable for keeping liquids. Ordinary corks may be used for bottles containing substances that do not attack cork. Glass-stoppered bottles will be needed for ammonium hydroxide, iodine in crystals or alcoholic solution, bleaching powder, and the acids. Lye, or sodium hydroxide, cannot be kept in even a glass-stoppered bottle, for the stopper will stick; a rubber stopper should therefore be used, or a bottle may be fitted with a cork that has been weighted and soaked in molten paraffin.

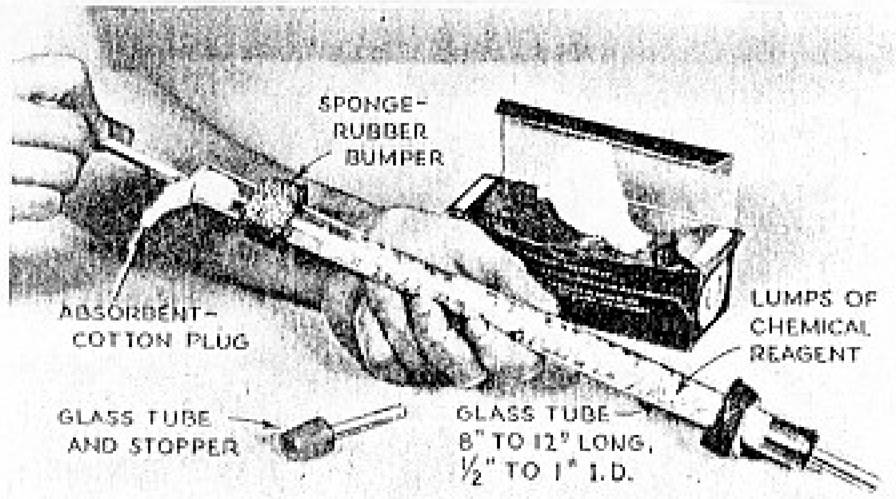
A raid on the kitchen and the family medicine chest will help fill your bottles with chemicals, if you can identify the ones you find there under their various aliases. The baking soda on the kitchen shelf is sodium bicarbonate, while sodium carbonate can be recognized as washing soda or sal soda. Epsom salts provide magnesium sulphate. Bleaching powder, sometimes labeled chloride of lime, contains calcium hypochlorite. Lye supplies you with sodium hydroxide, alum with potassium aluminum sulphate, and sal ammonia with ammonium chloride. Table salt consists principally of sodium chloride. Vinegar, which contains acetic acid, can be pressed into service when a very weak acid is needed for chemical experiments. Precipitated chalk is a form of calcium carbonate. Familiar chemicals that travel under their right names include sulphur, charcoal, boric (or boracic) acid, carbon tetrachloride, and denatured alcohol. Ammonia water, or household ammonia, is ammonium hydroxide; while the commercial form is not a pure one, it may nevertheless be used successfully in many chemical experiments.

A very strong and pure solution of ammonium hydroxide, if needed, is easy to make. When ammonia gas is bubbled through water, it dissolves, combining with the water to form ammonium hydroxide. Ammonia gas for this purpose may be generated by heating an alkali and an ammonium salt in a flask with a small amount of water. Ordinary household lye, or sodium

hydroxide, will serve for the alkali. The ammonium salt may be either ammonium sulphate or ammonium chloride; both are readily obtainable and very inexpensive.

The ammonia generating flask in which these substances are placed should be fitted with a one-hole stopper. A glass tube leads the gas to an outlet under water in a narrow vessel, such as an olive bottle. Keep the water cold, by standing the bottle in a can or jar of water and ice, as the formation of a strong solution would otherwise be impeded by the heat developed as the ammonia gas dissolves in the liquid.

Heat the flask, and you will observe that copious quantities of ammonia gas are produced. Bubbles coming from the outlet tube disappear in the water at the start, however, because the gas dissolves completely. The water in the bottle is well saturated with the gas when a strong odor of ammonia is produced by bubbles escaping from the liquid. At this point, you may remove the bottle and substitute another of fresh water, if more of the solution is desired. Wooden blocks will serve as a rest for the bottles, and may be slipped out when a bottle is to be changed.



A DRYING TUBE

To remove water vapor from gases generated in the laboratory, you can make this simple drying tube. Lumps of desiccated (anhydrous) calcium chloride are used to provide the drying action

Either an ammonium hydroxide solution prepared in this way, or ordinary household ammonia, may be used to demonstrate that ammonia gas will burn. Place whichever solution you choose in a flask that is fitted with a one-hole stopper, and heat it cautiously. This releases the ammonia gas. If a glass tube is placed in the cork, a lighted match held at its upper end will kindle the escaping vapors. The ammonia breaks down into the substances of which it is composed, nitrogen and hydrogen, and the latter burns.

The solution used in this experiment should be heated very gently, especially when household ammonia is used, as many present-day preparations will foam or froth. A Bunsen burner turned very low can be employed. If you have no gas supply at your chemical workbench, an alcohol lamp will do nicely.

In fact, an alcohol lamp is a more useful all-around source of heat in an amateur laboratory than is generally realized. While the ordinary type furnishes insufficient heat for many chemical experiments, this defect is easy to remedy. A tin can, suitably cut to serve as a shield, will prevent the loss of heat to the surrounding air. Remove the top of the can, or cut away the central portion to within half an inch of the outer rim; the latter procedure gives more rigidity. Detach the whole bottom of the can, and cut deep notches in the sides to admit air for combustion. When this fitting is placed over the lamp, the heat is concentrated where it is needed. Several layers of asbestos paper, wrapped around the upper part of the can and cemented over with dilute water-glass solution, will further reduce heat loss. A square of wire screen may be placed upon the top of the can to support a beaker or flask.

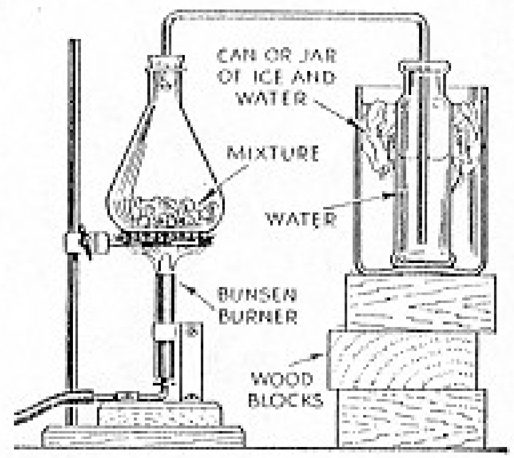
WHEN you use an ordinary alcohol lamp, the cork, which carries the wick, often catches fire. This may be prevented by placing a washer or disk of bright tin around the metal tube in which the wick passes through the cork. The shiny metal reflects the heat of the flame and also acts as a cooling fin for the tube. It is easily removed when the glass snuffer, or cap, of the lamp is to be replaced. Denatured alcohol is the best fuel for such a lamp; other kinds are expensive, or, like rubbing alcohol, contain water.

In the list of chemicals available in any home, even safety matches might have been included. Their heads contain potassium chlorate, from which you can liberate chlorine gas in order to observe its interesting properties. The quantity of chlorine gas produced is small, to be sure; but that is just as well, for the gas is so irritating that you would not care to generate a great deal of it indoors.

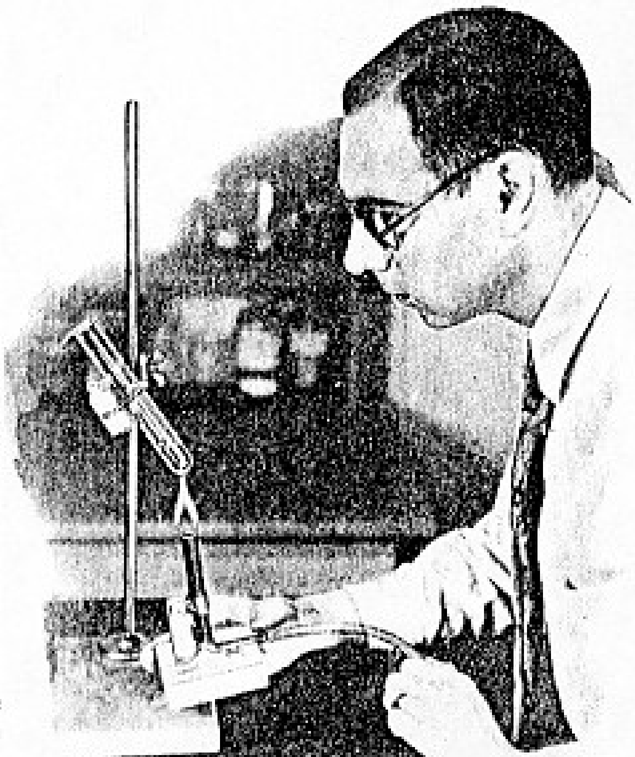
Place about a teaspoonful of water in a test tube, and drop in the heads of one or two safety matches. Add several drops of muriatic, or hydrochloric, acid, and heat the contents of the tube gently with a small flame. A Bunsen burner turned low, an alcohol lamp, or a candle will do. Have the test tube clamped to a support of some kind, so that your hands will be free. Be sure that the mouth of the test tube is pointing away from you; this is a good rule to follow whenever you are heating a liquid in an open tube, so that if the boiling contents should spatter they will not come your way.

DYE in the match heads may color the solution, but this will not interfere with the reaction that takes place when you heat the test tube. The hydrochloric acid and the potassium chlorate react with each other, releasing chlorine gas. You can readily detect the pungent odor of the chlorine by cautiously smelling the escaping vapor. Don't place your nose to the tube; a better way to detect the odor of any acrid gas, without risking getting too strong a whiff, is to keep the tube a little distance from you and waft the vapor gently toward you with your hand.

Chlorine has a powerful bleaching action on many dyed objects, as you can observe by moistening them and hanging them in the mouth of the test tube. Scraps of colored cloth and paper are turned white, and the dyed red portion of a safety-match box is also bleached; a sliver of it may be bent to a "V" shape and hung on the edge of the tube for this test A drop



Apparatus for preparing ammonium hydroxide. Gas generated in the flask is dissolved in water in the bottle



Chlorine gas, produced by heating a mixture of match heads and acid, is made to bleach wood

of silver nitrate, held in the mouth of the test tube on a glass rod or piece of tubing, turns white; the chlorine, reacting with the silver nitrate, produces a white precipitate of silver chloride. Brightly polished brass or cop-

per is quickly tarnished, and becomes coated with a green chloride of copper if it is exposed to the chlorine vapor for several minutes.

A stock way of of making hydrogen gas is to allow dilute sulphuric or hydrochloric acid to act upon zinc. Sulphuric acid and zinc will not always produce hydrogen, however, as you can easily demonstrate.

MIX two volumes of strong sulphuric acid with one part of water. Be careful to *pour the acid into the water*; if, instead, water is poured into strong sulphuric acid, the heat produced by the lively interaction is apt to turn the first few drops of water to steam and spatter the powerful acid upon anything in the vicinity. Place the acid-water mixture in a flask, add some pieces of zinc metal, and heat the contents of the flask gently.

Moisten a piece of white paper with several drops of lead acetate solution and hold it at the mouth of the flask; it will turn brown or black, indicating the presence of hydrogen sulphide gas. This is the gas produced under the circumstances of the experiment.

Still a different result is obtained if the sulphuric acid is undiluted. In this case, its reaction with the zinc produces sulphur dioxide gas.

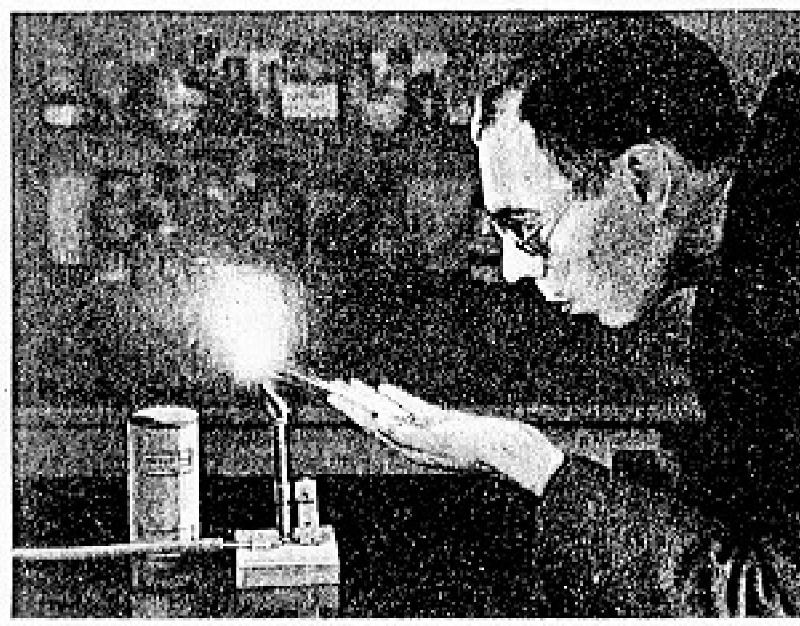
These experiments show that what happens when sulphuric acid and zinc react depends upon the strength or dilution of the acid. When hydrogen is the gas desired, the acid should be diluted in the proportion of one part to four or five of water. The same applies when hydrochloric acid is used.

For some of the experiments that you may perform with hydrogen, carbon dioxide, hydrogen sulphide, and other gases, it is desirable that they should be dried—that is, freed of the water vapor that they may contain as a result of ordinary laboratory methods of preparation. This may be done by passing them through a glass tube of half-inch to one-inch diameter, filled with granules of desiccated (anhydrous) calcium chloride, which acts as a dehydrating agent. To construct the drying tube, insert a wad of absorbent cotton, not too tightly packed, at one end of the tubing. Then close this end with a one-hole stopper carrying a glass tube, to which rubber tubing leading from other apparatus may be attached. The anyhydrous calcium chloride may now be poured in from the open end of the drying tube until it is nearly filled. A second wad of cotton is inserted at this end to keep the contents in place, and another one-hole stopper with a glass tube completes the assembly of the essential parts. A useful addition, however, is a pair of square "bumpers" cut from sponge rubber about one inch thick. When holes are cut in the "bumpers" and they are slipped over the tube, one near each end, they protect it from breaking and keep it from rolling about on the top of your chemical workbench.

Chemical MAGIC with Zinc

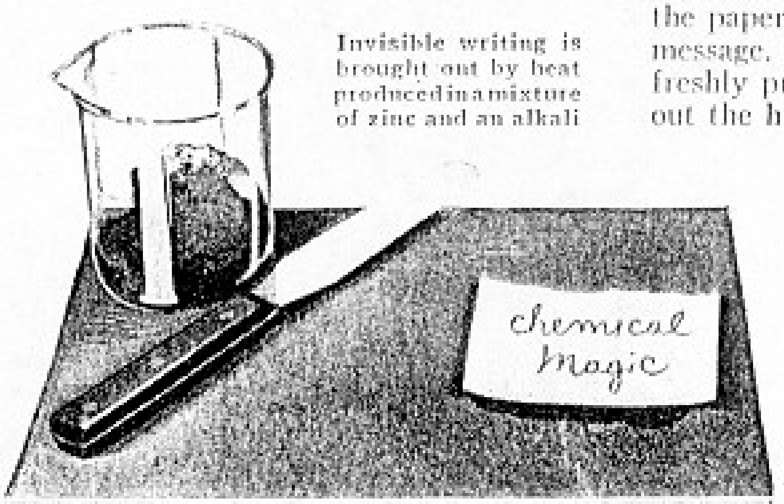
ENTERTAINING stunts of chemical magic can be performed with zinc in finely powdered form, which may be purchased from dealers in chemicals as "zinc dust."

A composition that takes fire spontaneously may be made by mixing the metallic powder with sodium hydroxide solution to form a paste. The exact strength of the last-named ingredient does not matter a great deal, but a ten-percent solution that is sure to be satisfactory can be made by dissolving about ten grams (two teaspoonfuls) of sodium hydroxide or lye in ninety to ninety-five cubic centimeters of water (an ordinary drinking glass holds about 240 cubic centimeters). Squeeze the zinc-alkali paste between sheets of stiff, absorbent paper to remove the excess sodium hydroxide solution, and then spread it out in a layer about one fourth of an inch thick. Within one or two minutes, of its own accord, the paste will steam, smoke, and finally catch fire, forming white clouds of zinc oxide as it burns.



Ordinary zinc stearate powder, blown into the flame of a Bunsen burner, produces a vivid, spectacular flash of light

Write some words upon a small square of paper, using a clean pen and employing a solution of a cobalt chemical—cobalt chloride dissolved in water, for instance —as ink. When the writing is dry, it will be invisible. Now prepare a layer of alkali-dampened zinc dust, as before, and lay upon it the paper with the invisible message. The heat from the freshly prepared paste develops or brings out the hidden writing.



Invisible writing is brought out by heat produced in a mixture of zinc and an alkali

The explanation of the paste's mysterious behavior is threefold. The alkali first dissolves some of the zinc oxide that is always present in zinc dust. The zinc itself also reacts with the alkali, as well as with the oxygen of the air. Each one of this series of reactions liberates heat, and their combined effect raises the temperature of the paste until the zinc metal actually takes fire and burns at the expense of the oxygen in the air. The paste should be spread on a surface that will not conduct heat rapidly.

Another way you can make zinc burn is to take a pinch of zinc dust in the palm of your hand, or place it in a small tube, and blow it into a flame. Its rapid combustion produces a vivid flash of light. Ordinary zinc stearate powder, found in many household medicine chests, can be used instead. In this case, the sound accompanying the flash, a harmless "woof," makes the demonstration still more impressive.

Continued from page 1919

that the salts thus formed produced a very peculiar physiological action upon animals, whether administered by subcutaneous injection or by the mouth; this application to adult cats developing in a very few minutes a condition of great excitement, almost amounting to delirium, and accompanied by a copious flow of saliva and a great dilatation of the pupils. This appeared to be due, in part, to increased sensitiveness to noise, and partly to an impulse to rush around. When the same tests were made with kittens, though there were the same general effects produced, the stage of excitement, which in adults passed off gradually in a few hours, was followed by a condition closely resembling that of alcoholic intoxication, especially in the want of coordination of muscular movements. Rabbits, on the contrary, appeared to be affected but little, or not at all. Vomiting was not observed in any of the cases experimented upon.

THE CALORIGEN—A NEW HEATING APPARATUS.

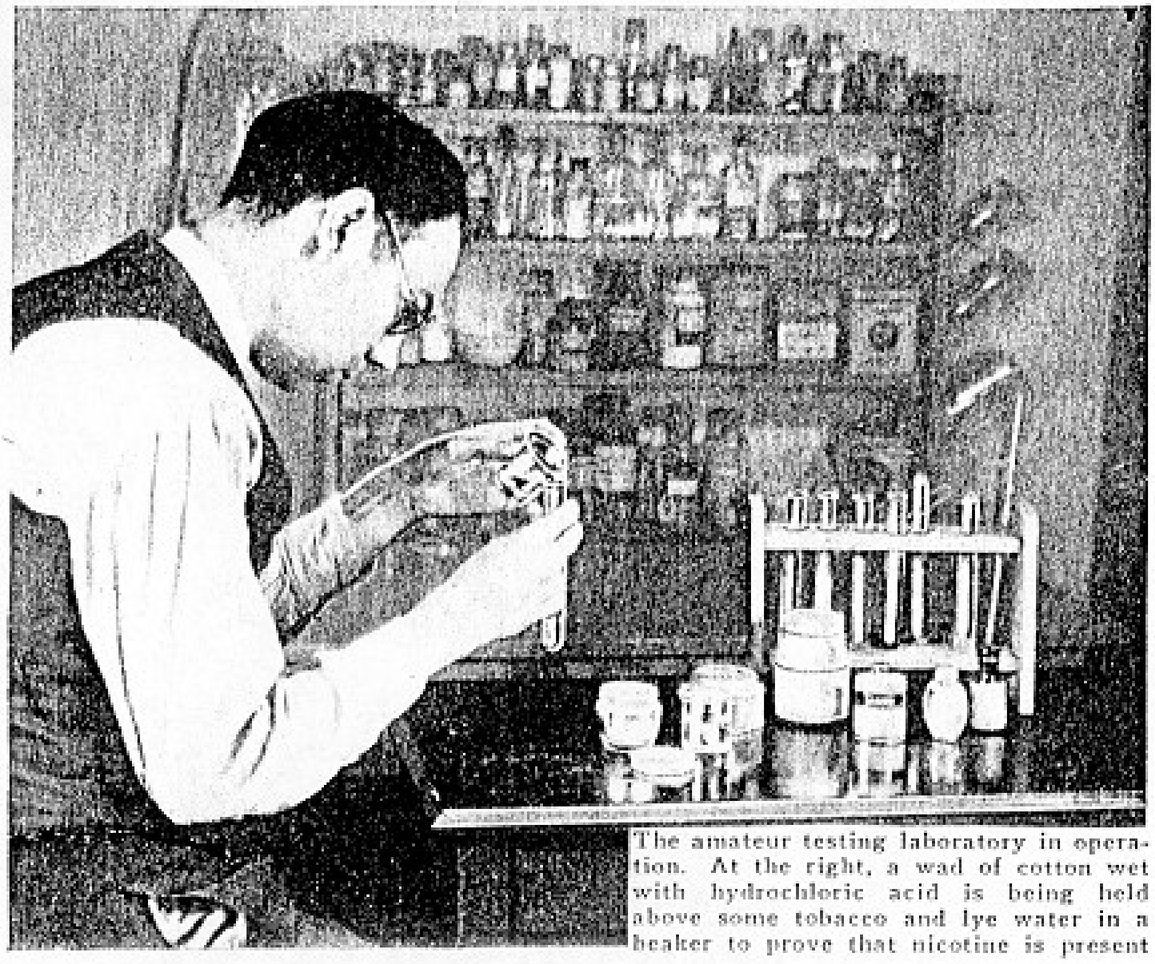
In a heating apparatus lately exhibited at the International Exhibition in London, and called the Calorigen by Mr. George, its inventor, the London *Mechanic's Magazine* finds what it considers to be a new principle in heating and ventilation, of very great merit. This arrangement claims not only to economize the combustion of

Continued on page 1925

What's It Made Of?

POPULAR SCIENCE MONTHLY
JULY, 1937

HOW TO ANALYZE HOUSEHOLD PRODUCTS IN YOUR OWN LABORATORY



The amateur testing laboratory in operation. At the right, a wad of cotton wet with hydrochloric acid is being held above some tobacco and lye water in a beaker to prove that nicotine is present

By
RAYMOND B. WAILES

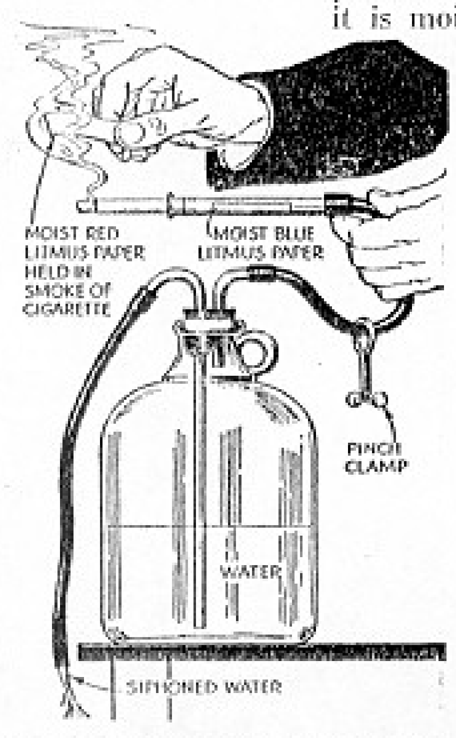
TESTING household products offers a fascinating and practical diversion for an amateur chemist. Simple experiments, well within the natural limitations of a home laboratory, will yield a surprising amount of information about such preparations as ammonia, medicines, tooth powder, cosmetics, tobacco, and a variety of others.

When you purchase a bottle of household ammonia, you actually are getting a solution of ammonia gas in water. In case two brands are similarly priced, the one containing the most ammonia is, presumably, the best buy. You can easily find out for yourself which is the stronger by "titrating" them with dilute sulphuric acid.

Place exactly equal amounts of the two brands of ammonia in separate test tubes—about ten cubic centimeters, or three teaspoonfuls, will do—and add to each test tube a drop or two of methyl orange indicator. Then add weak sulphuric acid, drop by drop, to one of the test tubes until the color of the solution changes from orange to red. Note the quantity of acid used. Repeat the test with the contents of the other tube. The ammonia that requires the most acid to effect the change is the stronger. If you add the acid from a graduated tube or burette, the exact amounts used may easily be compared. Acid of suitable strength for this test can be made by diluting three cubic centimeters of strong sulphuric acid with water, to a total volume of 100 cubic centimeters (a drinking glass contains about 240 cubic centimeters).

Drug-store remedies for indigestion usually consist of baking soda (sodium bicarbonate) combined with various other materials. Many of the brands contain some form of bismuth, and the presence of this comparatively high-priced ingredient can be detected by a simple but interesting test.

If the product is a powder, try heating some of it in a test tube with a mixture of powdered potassium iodide crystals and flowers of sulphur. If it contains bismuth, the resulting chemical reaction will release the vapor of bismuth iodide, which will condense as a scarlet solid on the inside wall of the test tube. This "sublimate" can best be identified with the aid of a magnifying glass, after the tube has cooled and the brown drops of distilled sulphur have turned yellow, as otherwise the sulphur may be mistaken for the scarlet bismuth iodide. To test a liquid preparation for bismuth, heat it in an evaporating dish until nothing but solid material remains, and proceed as before.



MECHANICAL SMOKER. This simple apparatus will "smoke" a cigarette while you analyze the chemical products in the fumes

Many tooth powders contain sodium perborate, which releases oxygen gas when it is moistened. One way to detect it is to test the tooth powder for boron, an element present in the perborate compound, which has the characteristic of turning a flame green.

Place some of the tooth powder in a test tube that has a side arm as shown in one of the photographs. Add enough strong sulphuric acid to cover the powder, and then an equal amount of grain or rubbing alcohol. Connect the side arm of the test tube, instead of the regular gas supply, to the gas inlet of a Bunsen burner and heat the contents of the test tube. You will find that you can light the gas issuing at the top of the burner, and the resulting flame will be colored green through the formation of a compound known as ethyl borate ester, if the tooth powder contains sodium perborate.

Oxygen released by a tooth powder of this type comes from the decomposition of the hydrogen peroxide that is formed through the interaction of sodium perborate and water. This provides another test for the tooth powder. If hydrogen peroxide is formed when it is moistened, it must contain the perborate compound.

You can test for hydrogen peroxide with an easily prepared solution made by dissolving five grams (about a teaspoonful) of ammonium molybdate crystals in fifty cubic centimeters of water and then adding fifty cubic centimeters of strong sulphuric acid. Several drops of this reagent, added to a solution obtained by stirring some of the tooth powder in a little water, will show up any hydrogen peroxide by turning the liquid yellow. You can make sure your reagent is working properly by trying it out in another test tube containing several drops of drugstore peroxide.

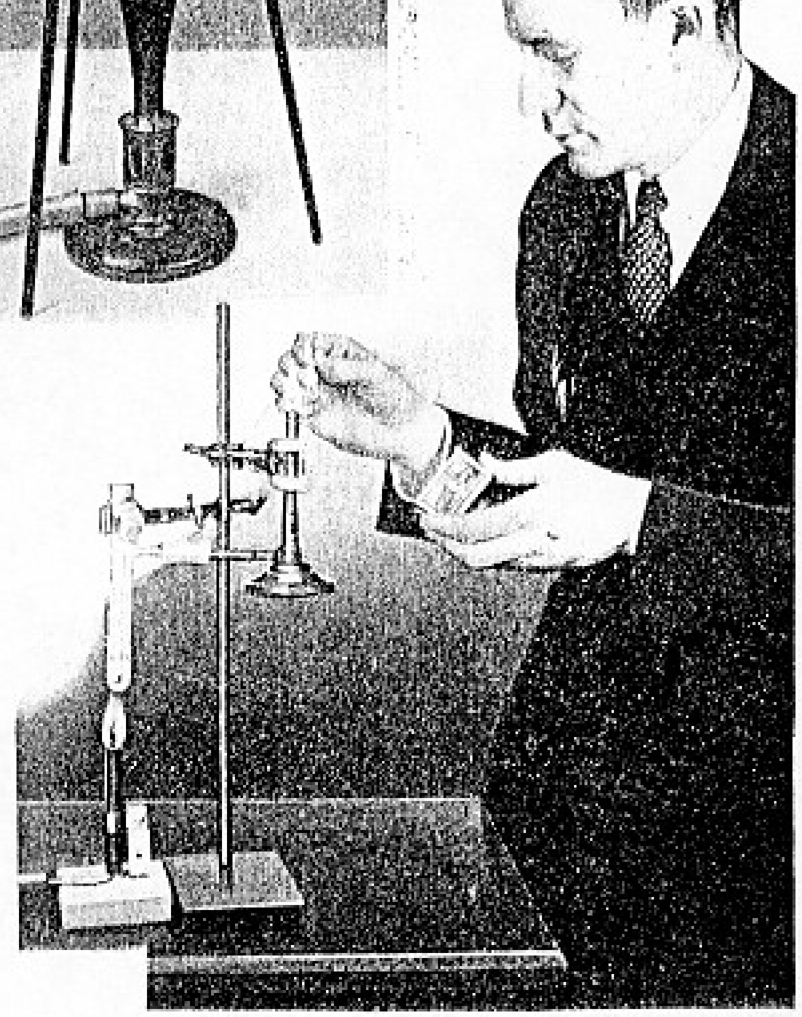
A variation of the preparation just described also can be used to test for the peroxide. Add a teaspoonful of a ten-percent ammonium molybdate solution to the liquid under test, followed by several drops of a dilute solution of citric acid. Again, a yellow color develops if hydrogen peroxide is present.

Add a few drops of salt water to a solution of silver nitrate, and you will observe a precipitate of silver chloride. The white precipitate will turn gray and then black when exposed to the light. Similarly, if you add several drops of a solution of sodium chloride, or table salt, to the liquid contained in the brown glass bottle furnished with many hair-dye "sets" or colors, a white precipitate will form. It turns grayish-black when exposed to the light, indicating that the amber bottle contains a soluble silver salt. In most hair dyes, this salt is silver nitrate.

A powder accompanies the hair dye. The instructions direct the buyer to dissolve this in water and apply it to the hair following the use of the silver nitrate solution. Try adding an acid, such as sulphuric acid, to the powder, and acrid sulphur dioxide gas will be liberated. If you treat a solution of the powder with several cubic centimeters of silver nitrate solution, you will obtain a brown precipitate that slowly turns dark. This silver precipitate is the agent that colors or dyes the hair. Reactions like those you have just observed indicate that the powder is a thiosulphate.

Some freckle-removing creams contain ammoniated mercury, which may prove harmful to the skin. A simple way to test for mercury in such a cream is to heat several grams of it with a dilute solution of lye or other caustic, stirring meanwhile with a glass rod. Then immerse a strip or sheet of metallic aluminum, such as the metal-foil wrapping from a candy bar, in the liquid. The caustic reacts with the aluminum, giving off hydrogen gas. At the same time, any mercury in the solution will amalgamate with the aluminum. Remove the aluminum foil, wash it thoroughly with water, and set it aside without attempting to dry it. If mercury is present, the foil soon will emit crackling noises, and a fluffy white growth of alumina will appear upon its surface.

Cigarette paper being reduced to ash to disclose the filler with which it may be "loaded." The crucible is supported on a nichrome-wire triangle



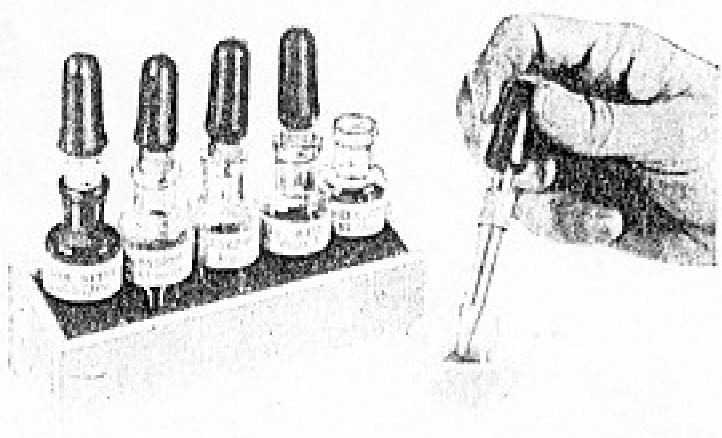
This test reveals the presence of sodium perborate in a tooth powder, which is heated in the test tube with sulphuric acid and alcohol

A modification of this test may be performed by heating together for a quarter of an hour a one-gram sample of the freckle cream, a strip of aluminum foil, a third of a teaspoonful each of five-percent sodium hydroxide solution and twenty-five-percent sodium thiosulphate solution. In this case, mercury is present if the growth of white alumina appears after the metal foil has been washed with alcohol or acetone.

Tobacco smoke, blown through a handkerchief, produces a brown stain—not of nicotine, as many suppose, but of vegetable tar distilled from the burning shreds. Extracting and testing for the nicotine itself is one of a number of interesting experiments you can perform with cigarettes, cigars, and cigarette paper in your own laboratory.

Handy Kit for Chemical Reagents

TO HOLD the small quantities of reagents used in "analytical" tests like these, you can make a neat and professional-looking little kit. Obtain a number of small bottles of uniform size, and fit them with medicine droppers, passed through holes in the stoppers. If the mouth of each bottle is small, you can simply slide a half-inch length of rubber tubing over the medicine dropper and use the dropper itself as the cork. A small wooden box of convenient dimensions keeps the bottles in order. Your kit may include "indicators" and other solutions that you frequently use about the laboratory, such as methyl orange, phenolphthalein, sulphuric acid, sodium hydroxide, and silver nitrate. As silver nitrate is decomposed by light, keep this chemical in a brown-glass bottle, or in an ordinary bottle painted with black varnish.



Indicator solutions for analyzing household products are kept conveniently in small bottles with medicine droppers

Pure nicotine is a colorless liquid. What a chemist means when he speaks of the "nicotine" in tobacco, however, is nicotine citrate or nicotine malate. These are nicotine salts of citric and malic acids, the acids familiar to us in lemon juice and in apple juice.

Calling a salt like nicotine citrate by the plain name of "nicotine" should not confuse you. When we speak of the potassium that plants need in the soil for their proper growth, for example, of course we mean some salt of the metal, such as potassium carbonate or potassium silicate, and not the metal itself. If the ground actually did contain metallic potassium, which reacts with water to produce fire, what a picturesque and terrifying place the earth would be each time it rained!

TO TEST for the nicotine in tobacco, break up several cigarettes or half a cigar in a tall jar, beaker, or glass vase, and add several fluid ounces of a solution of sodium hydroxide (lye water) to the tobacco. Now hold a blob of absorbent cotton, wet with strong hydrochloric acid, just above the contents of the vessel. You will see a dense white cloud of "smoke" form around the cotton.

The chemistry of the process is simple. The alkali or lye water releases the nicotine from its combination with citric or malic acid and forms free nicotine. As this liquid is highly volatile, some of it is liberated in the vessel as a vapor. Now, when the vapor of hydrochloric acid is introduced in the vessel by the acid-soaked cotton, the nicotine vapor reacts with it to form nicotine hydrochloride. This is the white "smoke" that is formed. You may recall that the vapors of hydrochloric acid and of ammonia also react to form white smoke, consisting of ammonium chloride, but you can readily show that ammonia is not involved in the present instance. A wet strip of red litmus paper, held in the vessel after the caustic is added, does not turn blue, showing that no ammonia vapor is released by the action of the alkali.

Large tobacco companies employ ingenious machines to smoke cigarettes mechanically and analyze the chemical products in the smoke. If you wish to investigate for yourself what happens when tobacco burns, you can easily rig up one of these "robot smokers" in simplified form.

Fit the tip of a cigarette into one end of a glass tube, which serves as a holder. Connect the other end of the tube to a glass L tube, using rubber tubing provided with a pinch clamp or a spring-type clothespin. Insert the L tube in one hole of a two-hole stopper fitted to a gallon jug of water, which acts as a suction pump. The other hole in the stopper carries a longer glass tube that dips into the water, and at the top of this tube a long section of rubber tubing is attached. The siphon is started by sucking on this rubber tubing. When you open and close the pinch clamp or spring clothespin, the cigarette in the holder can be smoked in puffs, realistically imitating the customary manner of smoking.

PLACE a wet strip of blue litmus paper in the glass tube that serves as the cigarette holder, and set the robot smoker working—or, if you are a user of tobacco, simply place the glass tube to your lips, without the attachments, and draw the smoke through it. Presently the litmus paper will turn red. The change is produced by formic acid and other acids contained in the smoke.

Quite different, however, is the smoke coming from the other end of the cigarette—the wisp that curls upward from the glowing tip, and that is not drawn into the mouth in smoking. Hold a wet strip of red litmus paper in this smoke, and the test paper will turn blue, showing the presence of an alkali—in this case, ammonia. If your eyes have ever smarted in a room that is cloudy with tobacco smoke, now you know why; the ammonia vapor released by the burning tobacco is largely responsible.

A bit of chemical testing also will give you an insight into the chemistry of cigarette paper. Often this material is "loaded," or impregnated with some filler, to make it more opaque and to control the rate of burning. This should in no sense be considered an adulterant, since it is not used to cheapen the product, but is incorporated with the paper pulp to serve a useful purpose. Calcium carbonate, the same material of which chalk and marble are composed, is the filler generally employed.

TO TEST for this material, reduce several sheets of cigarette paper to ash. The best way to do this is to heat the paper in a porcelain crucible or evaporating dish, using a Bunsen burner, until the carbon has been entirely burned out. This will leave a white ash behind. During the heating, the calcium carbonate will have been converted into calcium oxide, or quicklime. Add several drops of water to the ash, and calcium hydroxide, or slaked lime, will form and dissolve. Now, when you add a drop or two of phenolphthalein to the liquid, it will turn violet-red, showing the presence of an alkali. The alkali responsible for the appearance of this color comes from the calcium carbonate originally present in the cigarette paper.

Instead of adding phenolphthalein, you can dip a platinum wire in the solution you have prepared, and then hold the wire in the blue Bunsen flame. The presence of calcium tinges the flame with a carmine-red color. A little of the liquid may also be filtered and treated with a solution of ammonium oxalate. A white precipitate forms. When ammonium oxalate solution is added to a liquid under test, such a precipitate strongly indicates that the liquid contains calcium.

Continued from page 1922

gas or fuel in the utmost possible degree, but also to combine with this a thorough system of ventilation, by which all noxious products are removed as fast as formed, and the air left perfectly pure. It has been adapted by the inventor especially as a gas stove, although it is also used with coal and wood. The gas stove arrangement consists of a cylinder of rolled iron, closed at the top and bottom, so that the interior of the burner is entirely shut off from the atmosphere of the room. This cylinder is furnished with two pipes: one placed near the top to carry off the products of combustion, the other near the bottom to supply the air necessary for the combustion going on within it. These two pipes pass through the wall into a second vertical cylinder, parallel to the large cylinder inside. This chamber is open only at the top, causing the air entering the stove to come in contact with the heated air leaving it, acting as a natural regulator of the flow, and saving much waste of heat. It may at first sight appear impossible to maintain combustion under such circumstances; but we shall find a solution of the difficulty in the fact that a light and heavy gas being poured into a vessel at the same time, the light gas will rise to the top while the heavy will sink to the bottom. Thus in the Calorigen the fumes of the gas are carried out of the room without conveying away any of the air, and also without employing the principle called draught, as there is no communication between the furnace and the air of the room. The door of the stove, when shut, completely cuts it off, although it allows the light to be seen.

The next important feature in this invention is the introduction of a coil of wrought iron tubing, which communicates with the external atmosphere. This tube can be open to the apartment; and the air, entering and following the course of the tubes, provides a plentiful ventilation, already raised to a pleasant and healthful temperature. By this arrangement the usual course of procedure is reversed; those nuisances in an ordinary room, the spaces about the doors and windows, instead of being fertile sources of draught and discomfort, are the means by which the air passes out of the apartment.

CAUSE OF THE INCREASED EXPLOSIVENESS OF CERTAIN BODIES.

According to *Les Mondes*, the explosive properties of inflammable matter are not dependent on the elevation of the temperature of the atmosphere, but upon its hygrometric state, as explosions take place in winter as well as in summer. Gunpowder during a drought will acquire spontaneous explosive qualities, even without any elevation of temperature, and is more ready to act from the smallest spark. The least quantity of oxalic acid, however, is sufficient to prevent spontaneous action of explosive materials, and without, at the same time, modifying the propelling properties of the powders. Thus if a pulverulent mixture of sulphur and chlorate of potash, or any other combustible substance ready to furnish detonating compounds, be combined with one-third part of oxalic acid, and then heated even to the degree of fusion, there will be no explosion. The action of the acid is believed to have a catalytic influence that precedes the abandonment of the basic particle of water of this substance, any excess of acid being without effect upon the general result. It is suggested that this, if true, will have an important bearing upon the manufacture of explosive substances generally, in reality changing them at will from fulminates to simple explosives.

SPRINKLED FABRICS.

We have heretofore referred to a method for coloring the fabrics now so much in vogue, in which a ground color is dotted over with minute specks of different shade. We have since learned that after the dye is sprinkled upon the surface of the cloths or fabrics they should be folded face to face, and either passed between rollers or pressed by blocks, so as to drive in and further distribute the color on the cloths.

UTILIZATION OF IRON SLAG.

The utilization of the slag of iron furnaces, which is produced in such immense quantity, has long been a problem, although of late years many attempts have been made to solve it. Methods have been suggested for extracting various substances of value in the arts; and in some countries, Belgium especially, the material is cast into moulds of a definite shape, and used, without further preparation, for building purposes. All persons familiar with the iron districts where this substance is produced are aware of the excellent macadamized roads it makes in the neighborhood

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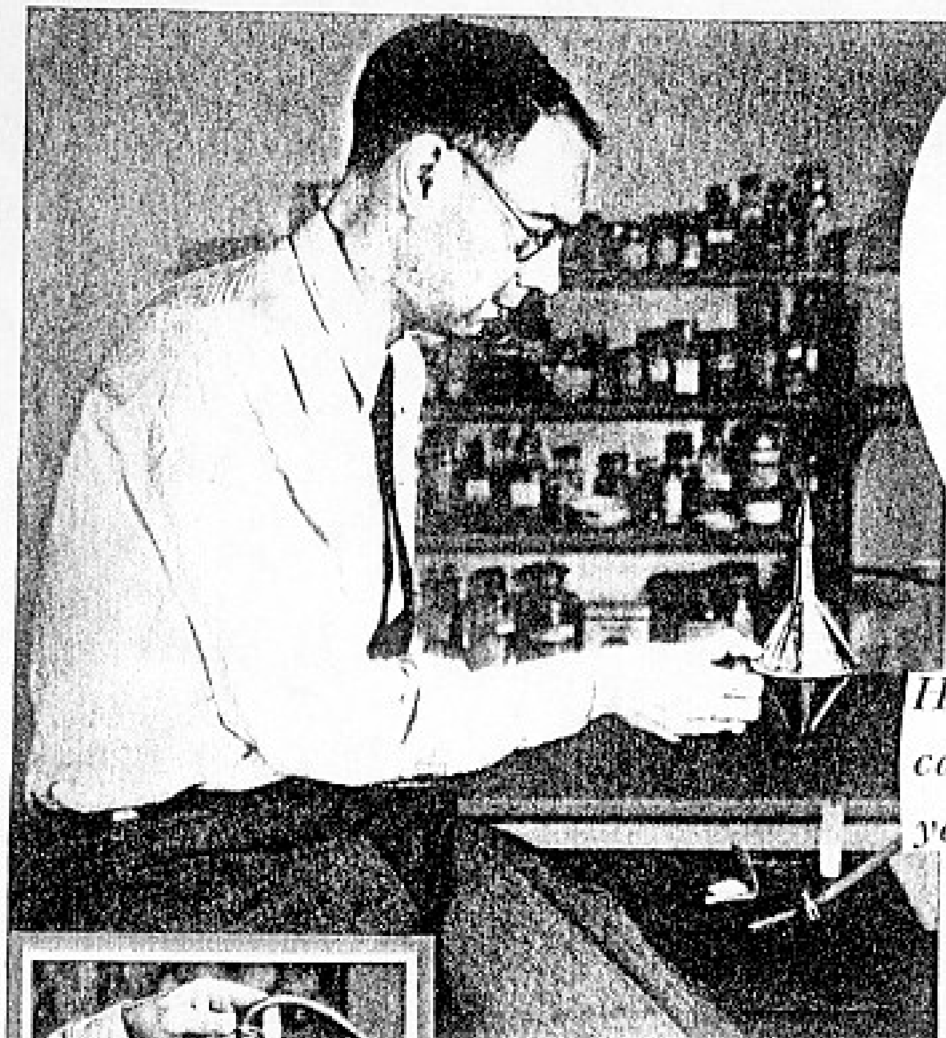
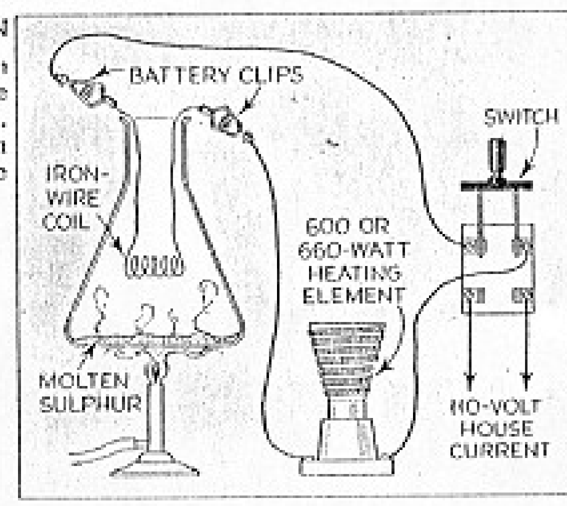


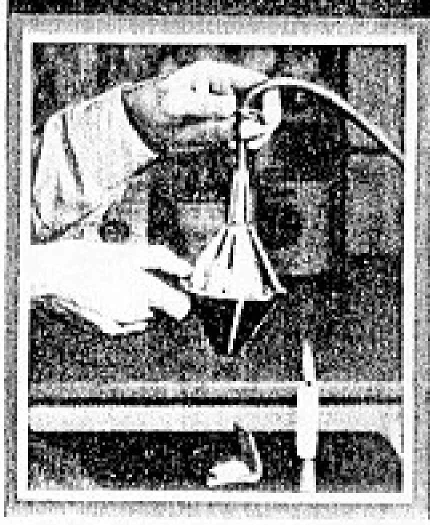
Home Chemistry WITH SIMPLE APPARATUS

Here are some easy chemical experiments that can be performed without elaborate equipment, yet are spectacular and filled with interest

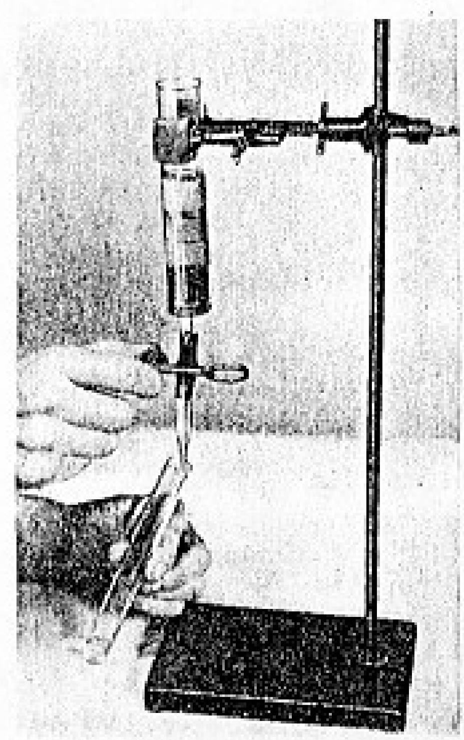
POPULAR SCIENCE MONTHLY DECEMBER, 1936

HEAT CAUSES REACTION
A coil of iron wire, hung in sulphur vapor, is heated by the passing of an electric current. When hot, the iron reacts with the vapor to form iron sulphide





FUNNELS MAKE "GAS PISTOL"
When this simple device is filled with gas, as at the left, and a flame is applied to the spout, a yellow flame is produced. Then, as air mixes with the gas, it pops loudly



DEMONSTRATING OSMOSIS
Water is being drawn from the bottom of the tube for tests to prove that the layers of liquid have mixed

By Raymond B. Wailes

SOME of the most interesting chemical experiments require only the simplest of apparatus and materials. Among such tests that you can add to your home-laboratory repertoire are making a "gas pistol" that produces harmless explosions; using a small electrical set-up to make metals react with a variety of vapors; and performing a "slow-motion" diffusion experiment in which you will learn how to identify different kinds of alcohol.

The gas pistol is made from a pair of ordinary kitchen funnels fastened together at the large ends. If you use tin funnels, the edges will be easy to join with solder. In case the funnels are of aluminum, or if you are inexperienced in soldering, a strip of adhesive tape will make a sufficiently tight joint. Remove the spout of one of the funnels, smoothing any sharp edges that are left.

Hold your gas pistol with the remaining spout up, and fill the interior with illuminating gas. The gas may be admitted through a rubber tube fitted with a pinch clamp, and you can then hold the tube against the funnel spout and control the gas supply with the same hand. In case your laboratory workbench is not piped for gas, it should not be difficult to find a place nearby where a connection can be made.

When all the air in the pistol has been displaced by gas, which will take about ten seconds, close the pinch clamp, and remove the supply tube. Immediately apply a lighted candle, kept ready for the purpose, to the spout. A yellow flame is produced as the candle ignites gas driven from the spout by air entering the pistol at the bottom. At first, the gas is unmixed with air, and will burn but not explode.

As you watch, however, the gas flame becomes smaller and paler. This is because air entering the pistol from below is now mixing with the gas. Before long, sufficient air will have entered to form an explosive mixture with the gas. When this happens, the flame suddenly travels down into the pistol and a mild explosion occurs. It is entirely harmless, because of the small quantity of gas used and the fact that the explosion products are not closely confined. Usually, the explosion occurs a few

seconds after the gas is lighted, but you can delay it, if you wish, by pinching the spout of the funnel to reduce the size of the orifice.

Metals and nonmetals, such as iron and sulphur, react with each other to form a number of interesting compounds, but often it takes a high temperature to make the reaction occur. There is a simple way to provide this high temperature and to keep it under perfect control. All you need to do is make a coil of wire of the desired metal, heat it electrically, and surround it with whatever vapor you choose for the combination.

To make iron and sulphur interact, for instance, obtain some iron wire of about No. 30 gauge, B. & S. standard—which can be bought in spools at ten-cent stores—or unravel a single strand from a piece of picture wire. A length of about a foot is required for a single experiment. Make it into a coil and connect it to a household electric outlet in combination with an electric iron, a toaster, the heating element of a radiant heater, or any other appliance having a rating of about 600 to 660 watts. The connection should be made "in series," as shown in an accompanying diagram. A switch should be added to enable you to turn the current on or off at will.

Test the coil you have made by closing the switch. If the wire is of the right size, it should glow red-hot when the current is turned on. Wire that is too thin will burn out, while wire that is too thick will not get hot at all. By experiment, you can determine the right size to use.

Suspend the electric coil in a flask containing flowers of sulphur, or common powdered sulphur, and heat the flask. When the molten sulphur has begun to boil, close the electric switch momentarily. There will be a gentle, harmless explosion as the heated wire ignites the mixture of sulphur vapor and air in the flask. The current should be cut off at once to keep the wire from burning out. After the explosion, the interior of the flask becomes clear and transparent as the vapor clears. If the current is not allowed to flow too long at a time, the miniature explosion can be repeated again and again.

Finally, with the current kept on, the coil will remain red-hot and the chemical reaction between it and the sulphur vapor will take place. The surface of the wire first seems to boil as if it were molten. Suddenly, the interaction occurs, so rapidly and with so much generation of heat that the wire immediately burns out. A residue of ferrous sulphide, or iron sulphide, remains.

Try repeating this experiment, using sulphur as before but substituting wires of other metals for the iron wire. You will find it interesting to compare the compounds formed, which are sulphides of the respective metals. Avoid using magnesium metal for this purpose, however; it reacts so vigorously with sulphur that, under certain conditions, the experiment might be hazardous.

Many other vapors besides sulphur can be induced to combine with metals at high temperatures, as you can show with the apparatus just described. Place potassium chlorate, mixed with a little manganese dioxide, in the flask instead of sulphur, and you will obtain oxygen vapor when the vessel is heated. In an atmosphere of this gas, hot iron wire burns with dazzling brilliancy.

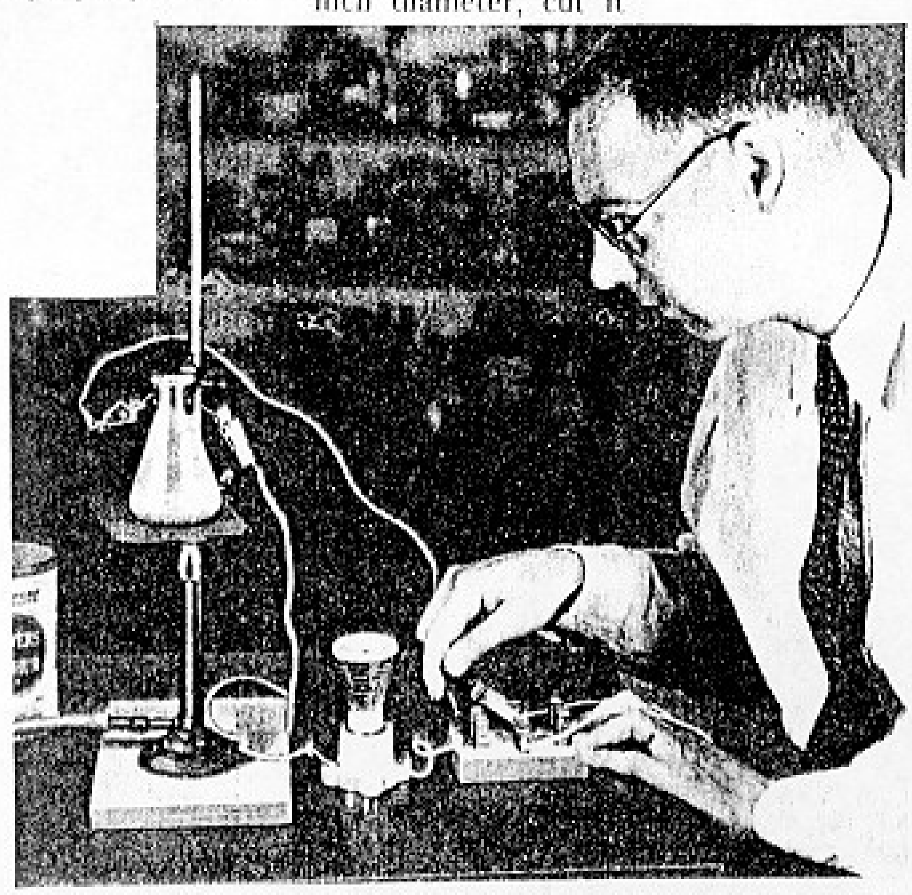
Other suitable materials will enable you to try the effect of chlorine, iodine, and carbon dioxide gases upon electrically heated coils of metal wire. Iodine vapor may be obtained by heating the pure, solid crystals. Do not use tincture of iodine, the common household preparation, in this experiment; the alcohol it contains would form a vapor that might cause an undesirably powerful explosion when ignited by the hot wire.

Magnesium metal can safely be used in an electrically heated coil surrounded by an atmosphere of carbon dioxide. If this interesting experiment is properly carried out, you should observe white magnesium oxide, or magnesia, formed from the metal, and free carbon liberated in flaky form.

Another experiment with magnesium, dispensing with the use of the electrical hook-up, will show how the silvery metal reacts with steam. Boil water in a flask and lead the vapor through a glass tube containing a piece of magnesium ribbon, made bright with emery cloth. After the steam has passed over the metal for a few minutes, you will notice a white crust of magnesium oxide deposited on the ribbon and on the walls of the tube. The metal decomposes the water vapor and combines with its oxygen. Hydrogen gas is released, although in such minute quantities that it would ordinarily escape detection.

Demonstrations of the phenomena of diffusion and osmosis, which have to do with the intermingling of substances because of the motions of their molecules, might be called "lazy man's experiments." After liquids used in such tests have been placed in layers in a vessel, there is nothing more to do but wait until the action goes to completion, which may take weeks.

To perform one of these slow-motion experiments, select a piece of glass tubing of half-inch or one-inch diameter, cut it



to a six-inch length, and mount it upright. Assemble a medicine-dropper tip, a rubber tube with a pinch clamp, and a short length of glass tubing, and pass the latter through a one-hole stopper inserted in the bottom of the vertical tubing. Now pour water into the main tube until the liquid stands about an inch above its bottom. Next, add a half-inch layer of castor oil or of turpentine, above the water; and, finally, a top layer of alcohol that has already been diluted with an equal volume of water. The apparatus may then be put away to stand for several days.

The difference in specific gravities of the three liquid layers tends to keep them apart, but it is insufficient to keep molecular action from mixing them. Within a week, at most, an appreciable amount of alcohol will have diffused downward through the central oil layer and will have reached the water at the bottom. Molecules of water also tend to migrate upward toward the alcohol, but the extreme insolubility of water in the dividing layer prevents this action from going far. The oil or turpentine might be said to act as a semipermeable "liquid membrane."

That the alcohol does reach the water after a few days can be demonstrated by opening the pinch clamp and drawing off a little of the bottom liquid into a test tube, the medicine-dropper arrangement acting as an improvised separatory funnel for this purpose. The presence of alcohol in the water may then be proved by a simple chemical test.

If you used grain, or ethyl, alcohol for the experiment, add several drops of strong sulphuric acid and a drop of acetic acid to the liquid sample you have drawn off. Then heat the contents of the test tube. A fruit-like odor, resulting from the formation of a compound called ethyl acetate, shows the presence of ethyl alcohol.

IN CASE you used wood, or methyl, alcohol for the test, add a small quantity of salicylic acid crystals and several drops of strong sulphuric acid to the drawn-off sample. When the test tube containing this mixture is heated, the odor of methyl salicylate, or artificial oil of wintergreen, will indicate that methyl alcohol was present.

Solids as well as liquids diffuse through the movement of their molecules. This action can be demonstrated by a very simple experiment. All you will need is some clear gelatin and two dyes of different colors.

Prepare a solution of the gelatin and make three molds into which it can be poured to form slabs not more than two inches square and about as thick as a slice of bread. After the molds have been poured, add different-colored dyes to two of the slabs, leaving the third clear.

When the slabs have set, place them together sandwich-like, with the clear piece in the middle, under a glass tumbler so that the gelatin will not become dry and brittle. Allow them to stand this way for several days. Examine them daily and you will see that the colors of the two slabs containing dye slowly make their appearance in the clear portion, indicating that diffusion has taken place between the solid pieces of gelatin.

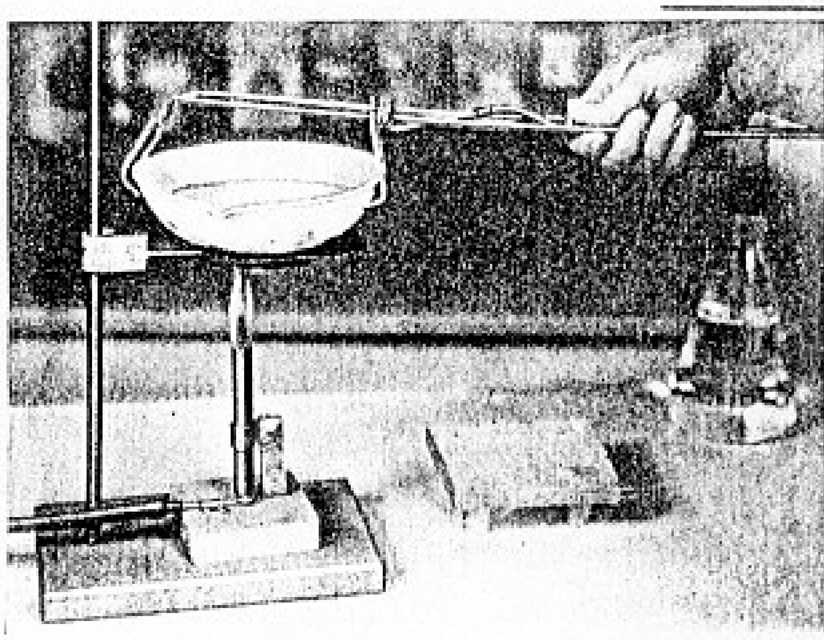
Continued from page 1925

of the iron furnaces; and it is now transported to considerable distances in England for a similar purpose. The best method of applying it is said to be by breaking it up into cubes of about six inches, laying the roadway with them, and then covering the whole with fragments, broken to about two inches in size, to a depth of about four inches (making ten inches in all), after which the road is to be well watered, and crushed with a heavy roller. In this way an almost solid bed is made, which is entirely free from mud, almost so from dust, and of uncommon durability. Indeed, this method seems to have given so much satisfaction lately in England that preparations are being made to use it for paving certain portions of London, with the anticipation that it will answer much better than the asphaltum rock heretofore imported from France, and applied there to a similar purpose.

PHOSPHOROUS BRONZES.

A great advance has lately been made in the construction of bronzes by the addition of a small percentage of phosphorus, although the precise function of this substance has not been hitherto well understood. According to Levi and Kunzel, however, one cause of the inferiority in bronze consists in the constant presence of traces of tin in the state of an oxide, which acts mechanically by separating the molecules of the alloy, thus interposing a substance which in itself has no tenacity. The addition of phosphorus reduces this oxide, and renders the alloy much more perfect, improving its color, its tenacity, and all its physical properties. The grain of its fracture resembles more that of steel, its elasticity is much augmented, and its resistance to pressure sometimes more than doubled. Its durability is greater, and, when melted, it is of greater

Continued on page 1932



Lifter for Evaporating Dish

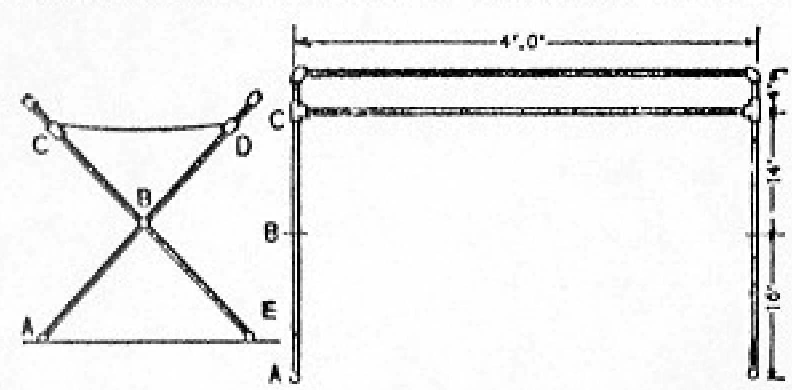
A PIE-PLATE HOLDER makes a useful laboratory accessory for lifting large, flat evaporating dishes with their hot contents from the flame of your Bunsen burner. Ordinarily used for taking a hot pie from an oven, an implement of this kind can be obtained for ten or fifteen cents at shops dealing in household novelties, or at the kitchen counters of ten-cent stores. It comes in handy when good-sized batches of chemicals are evaporated or digested, as shown in the photograph.

POPULAR MECHANICS

June, 1902

CHILD'S COT OF GAS PIPE.

A serviceable and neat child's cot can very easily be made of 3/8-inch gas pipe and fittings, says the Metal Worker. The two rectangular frames formed by the elevated side rails and the rails to which the canvas is stitched are put together without unions, by means of a long thread. The distance from A to B



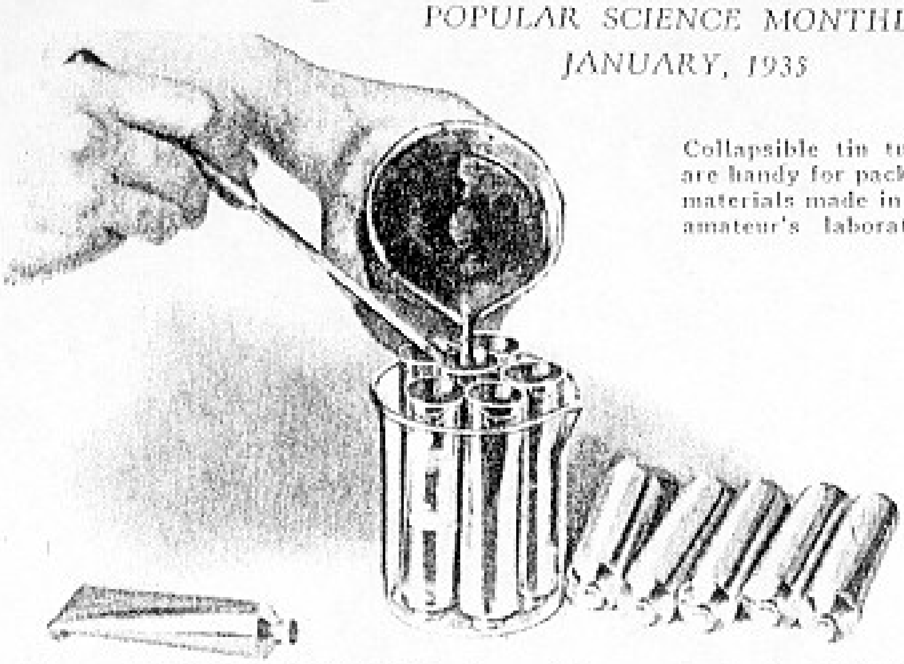
Gas Pipe Cot—Easy to Make.

should be greater than the distance from B to D, so that the base from A to E shall be greater than the spread of the canvas from C to D. The canvas should be wider than enough to reach across the side bars when the cot is in use, and securely stitched to the side frames. By using larger pipe a cot for adults may be made on the same plan.

Things to Make in Your Home Lab

POPULAR SCIENCE MONTHLY
JANUARY, 1933

Products of Industrial Chemistry May Be Reproduced by the Amateur, Supplying Useful Things at Low Cost



Collapsible tin tubes are handy for packing materials made in the amateur's laboratory

By RAYMOND B. WAILES

MONEY-SAVING, instructive experiments await the home chemist who turns amateur manufacturer. With his meager supply of beakers and bottles, he can make many valuable everyday substances that will reveal the mysteries of industrial chemistry.

It is perfectly possible, for instance, for the amateur experimenter to make his own writing ink. With very little trouble he can compound a so-called "standard ink," simply by using the following government formula as a guide: Tannic acid (eleven and seven-tenths grams), gallic acid (three and eight-tenths grams), ferrous sulphate (fifteen grams), hydrochloric acid (three cubic centimeters), carbolic acid (one gram), water-soluble blue dye (three and five-tenths grams), and 1,000 cubic centimeters of water.

The ferrous sulphate in this formula is our old friend iron sulphate, or copperas. If hydrochloric acid is not handy, muriatic acid can be used in its place, or sulphuric acid (two cubic centimeters) can be substituted. The tannic and gallic acids, strange as it may seem, are crystals. For the carbolic acid, the amateur will do best to have his corner drug store make up a solution containing five or ten centimeters of water, the entire amount being substituted for the one gram called for in the formula. The blue dye should be water-soluble, china-blue aniline dye. Methylene blue dye cannot be used as it causes a troublesome precipitation when the ink is made.

Although best results will be obtained if a small photographic balance is used to weigh out the chemicals, the experimenter lacking this piece of equipment can approximate the weights by allowing one teaspoonful for each five grams of any chemical. For the liquid measure, an ordinary eight-ounce drinking glass can be considered as holding about 240 cubic centimeters.

In following the formula, first dissolve the tannic and gallic acid crystals in about 400 cubic centimeters of water. In another beaker, containing 200 cubic cen-

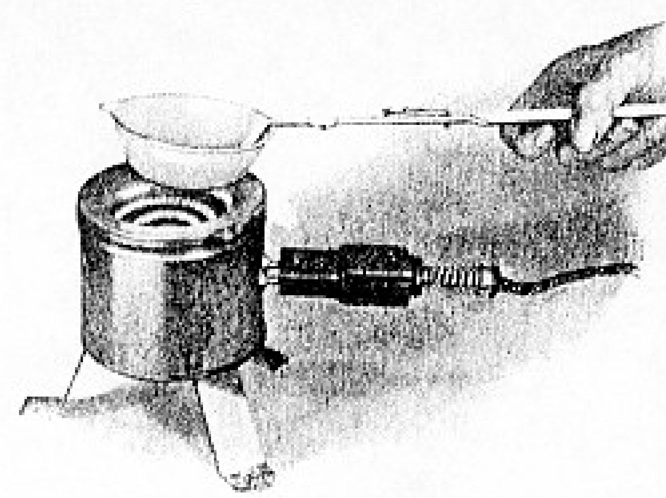
Easily Made Electric Heater for Crucibles

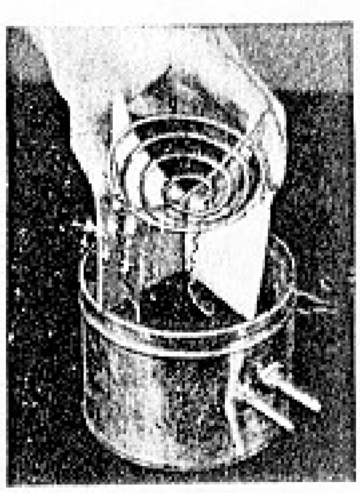
FEW materials are needed to construct the handy electric crucible or evaporating-dish heater illustrated. A tin can, a heating element, some wire, two connecting lugs, and some furnace cement complete the list.

Any shallow tin can having a large diameter can be used as the main container. The connecting lugs, obtainable from your neighborhood electrician or supply store, are the type used on electric irons and large heaters. The electric heating wire can either be bought or salvaged from a discarded 110-volt room heater or other appliance.

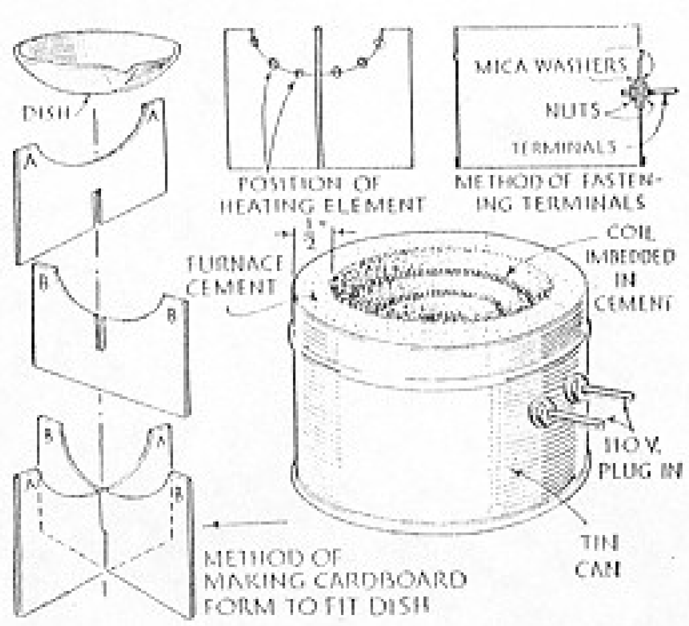
The heating element first is wound, spiral fashion, on a form made by slitting a cross-shaped assembly of stiff cardboard. The ends of the heating element are in turn connected to the inside ends of the plug terminals soldered in holes punched in the can. Then, with the heating element and its form in place inside the can, furnace cement is tamped in until it comes within a quarter inch or so of the heating element. After this layer of cement has been allowed to dry, more cement is applied and the finishing touches put on.

Finally, after a thorough drying, the heater is ready for use. If any cracks should form during the drying process, the surface should be wetted and patched with a new batch of the furnace cement. Legs, cut from sheet iron, can be soldered to the bottom of the can as a finishing touch. If your laboratory lacks a pair of crucible tongs, a good substitute is available at most five- and ten-cent stores in the form of long-nosed pliers.





Placing the heating element in the tin can. Upper right, the finished heater in use. The tongs are ten-cent pliers

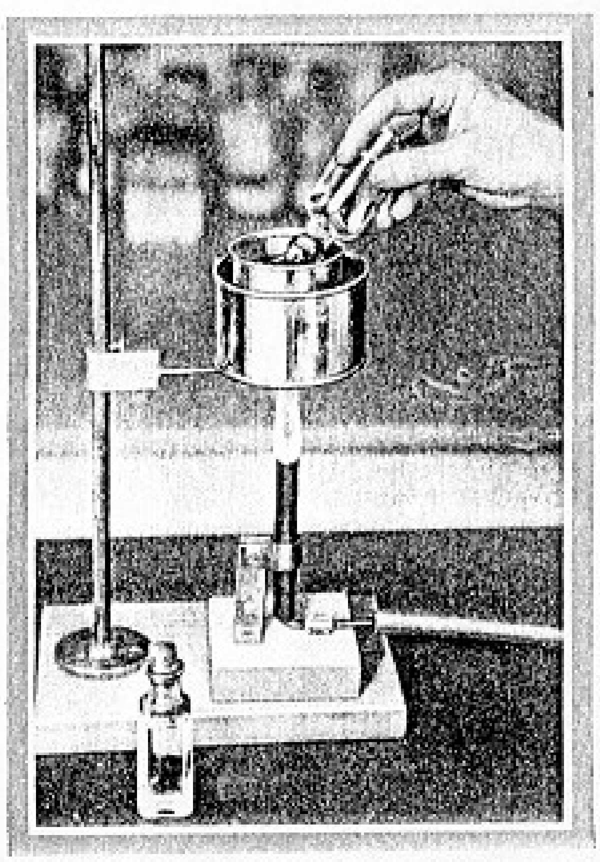


timeters of water, place the ferrous sulphate and the hydrochloric or sulphuric acid. The dye then should be dissolved in 200 cubic centimeters of water placed in a third container. When all three solutions are ready, mix them together and add the carbolic acid solution and enough additional water to bring the total solution up to about 1,000 cubic centimeters in volume. A part of this water can be used to rinse out the containers.

Pour the resulting ink into a bottle, leaving practically no air space at the top, and stopper it tightly. The ink is then ready for aging, a process that may vary from twelve hours to several weeks. The longer the ink ages, the freer it will be of suspended particles.

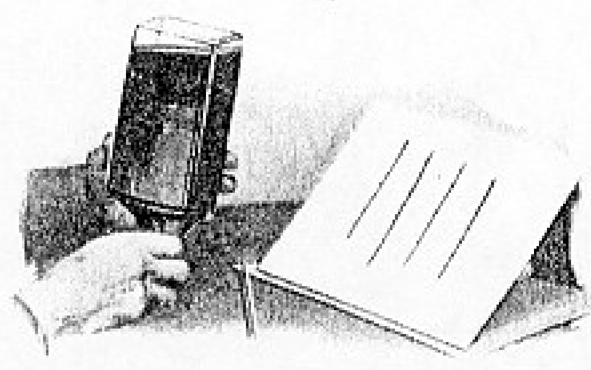
IF YOU have followed the instructions carefully, your completed solution will be a good grade of ink, known to industrial chemists as blue-black iron gallo-tannic ink. The chemistry of this ink is easily understood. First of all, the ferrous sulphate combines to form iron tannate and iron gallate when it comes in contact with the solution of tannic and gallic acids. When exposed to the air for some time, these substances turn black and are responsible for the black color the ink assumes after it has dried. The original blue color obtained when the ink flows from your pen comes from the blue dye. If a dye were not used, the writing would not be visible for several days until the iron compounds turned black. The hydrochloric or sulphuric acid serves to prevent the ink from forming a sediment, while the carbolic acid acts as a preservative to prevent mold.

Inks of other colors can be made by using different dyes. Violet, for instance, can be made by using methyl violet dye



Skin-tight cappings may be placed on bottles by dipping the corked necks into a hot mixture of cooking gelatin, glycerin, and water

In making ink and other things, a small balance is needed for weighing the chemicals. Papers are placed on both scales, and the material to be weighed is then conveyed to the pan upon a spatula. If a balance is not available, weights can be roughly gauged by measuring in a teaspoon



A good ink will show no sediment after standing for twenty-four hours. Tests for fluidity and opaqueness are also made easily

while black can be had by employing soluble nigrosine dye. Incidentally, nigrosine dye yields a legible ink when merely dissolved in water, but the resulting solution can hardly be classed as a permanent ink.

Although not exactly part of the ink manufacturing process, the standard tests used to determine the quality of ink form interesting experiments for the amateur ink maker. One simple yardstick of quality is known as the spreading or fluidity test. This is accomplished by allowing a definite volume of the ink, about five or six drops, to fall on a sheet of paper resting on a piece of glass inclined at forty-five degrees. The ink being tested should show approximately the same tendency to spread as other inks. Be sure, however, to use the same volume of each ink.

After a week or so of aging, homemade ink can be subjected to the opaqueness test to determine its blackness by comparing the various streaks obtained in the fluidity test. Also, by soaking the paper containing the streaks of ink in water, or a fifty-percent solution of denatured alcohol, for about twenty-four hours, some idea of the comparative weathering and washability characteristics of the inks used can be obtained.

Once the theory of an iron ink is understood it is a simple matter to grasp the action of ink removers or eradicators. Most two-solution ink eradicators consist of a solution of bleaching powder in water and one of oxalic acid. In use, the bleaching powder solution is first daubed on the ink spot, allowed to remain a minute, and the surplus blotted off. Then, the oxalic acid solution is applied. The action of the two solutions is first to bleach the dye used in the ink and then to dissolve the iron compound. Another method of eradicating ink consists of soaking the spot with a one-percent solution of potassium permanganate and then following with sodium thiosulphate or "hypo" solution until the ink is colorless.

BY MIXING cream of tartar (potassium bitartrate) and potassium binoxalate to a paste, the home chemist can provide himself with an excellent remover of rust spots. Simply wet the fabric in the area of the spot and apply the paste. Soon the brown rust stain will become colorless and at this point the cloth should be rinsed in water. In using these chemicals, the amateur should remember that both binoxalates and oxalates are poisonous.

Even the manufacture of a good metal polish is entirely within the scope of the home laboratory. All that is required is some whiting, precipitated chalk, crocus martis (finely divided iron oxide), and ortho-dichlorbenzine. Mix the first three in equal quantities and then wet them with the ortho-dichlorbenzine. This will form a paste polish. If a liquid polish is desired, mix ortho-dichlorbenzine with an equal volume of oleic acid. Both polishes should be

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applied with a cloth and rubbed briskly.

If the paste-type polish is made sufficiently fluid by using enough ortho-dichlorbenzine, the home experimenter can store it in convenient collapsible tin tubes in the true commercial manner. Unfilled collapsible tubes can be purchased at almost any drug store. Simply pour in the paste and fold and pinch over the ends.

ANY one of a number of simple formulas can be used by the home chemist in manufacturing his own transparent cement. Although a fairly good product can be obtained simply by dissolving scraps of celluloid in acetone or amyl acetate, a far better adhesive can be made by using cellulose acetate in place of the celluloid. The product then will be non-inflammable but because of the solvent used will have a tendency to blush or whiten as it evaporates. To prevent this, an additional solvent, ethyl lactate, can be added. Being what is known as a "high boiler," it will raise the boiling point of the mixture and retard the evaporation of the solvent.

Taking all of these suggestions into consideration, the home chemist will find that one of the best cements will consist of the following: acetone (ninety cubic centimeters), ethyl lactate (ten cubic centimeters), and cellulose acetate (ten grams). If the resulting cement is too thin, it can be thickened by adding more cellulose acetate. Incidentally, it will take the cellulose acetate at least two days to dissolve in the solvent so do not be in a hurry to put your finished cement to work.

Another cement employing a plastizer to improve its bending and flexing qualities can be made by mixing cellulose acetate with about twenty-five percent of its weight of ethyl phthalate and dissolving it in a liquid made by mixing acetone (fifty parts), ethyl lactate (twenty parts), ethyl acetate (fifteen parts), and toluene (fifteen parts). The resulting cement can be used on any material except rubber and may be packaged in collapsible tubes if some precaution is taken to keep them air-tight.

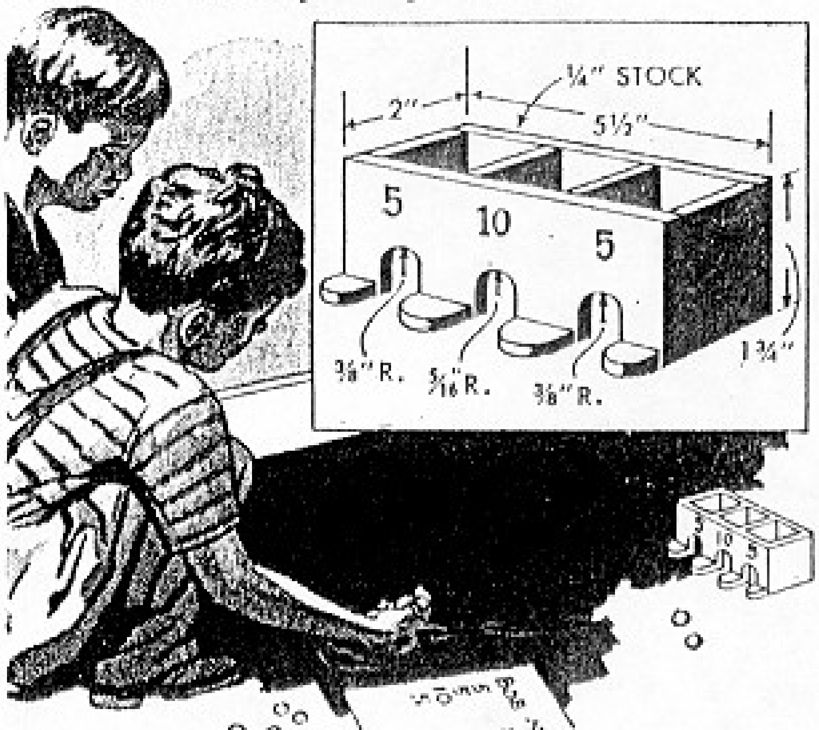
Perhaps you have at some time wondered about the transparent, jellylike caps often used to cover the stoppers on medicine bottles, iodine vials, and pill jars. These too can be made in the home laboratory. In fact, the home chemist can put them to good use in keeping his stored chemicals fresh and free from moisture.

THE inexpensive mixture used in making the jellylike coating consists of unflavored and unsweetened cooking gelatine (eleven grams), water (seven cubic centimeters), and ten drops of glycerin. Heat the mixture slowly over a water bath, stirring it continually. When a liquid results, dip the stoppered ends of several bottles into the solution and allow them to dry. After several hours, their necks and corks will be encased in the same celluloidlike caps that you have always associated with a drug store. If colored caps are desired, the mixture can be colored with any ordinary household dye.

POPULAR MECHANICS

Dec., 1952

Partitioned Box and Marbles Provide Rainy-Day Game



Here is a marble game assembled from scrap wood that children can enjoy indoors on rainy days. A box of the dimensions shown in the illustration is put together with glue and nails. It then is stained or painted and numerals placed above the three openings for scoring purposes. The game is scored by rolling glass marbles into the openings in the box.

I. M. Fenn, Chicago.

Feb., 1951

Wooden Partitions for Hog Troughs Prevent Crowding at Feeding Time

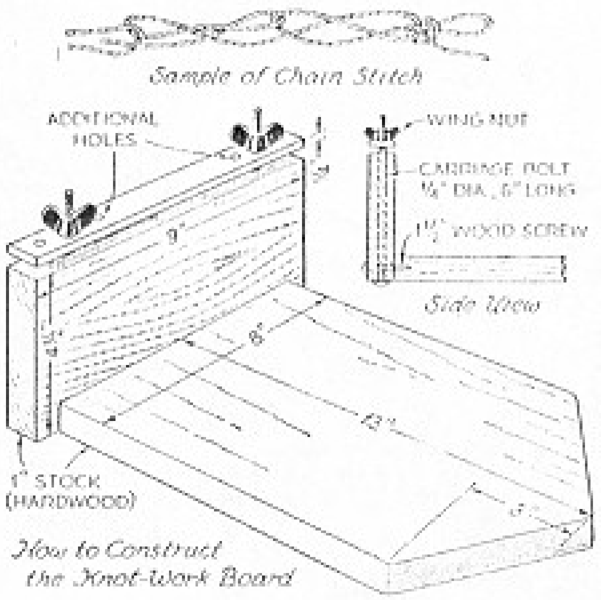
Partitioning the hog trough as pictured will assure that smaller pigs get their full share at feeding time. Built of 1 x 4-in. stock, with the uprights fitted into notches cut in the sides of the trough, the zigzag partitions are spaced 18 in. apart. This allows plenty of room for each hog and prevents crowding as milk, grain or other feed is poured into the trough.

POPULAR SCIENCE MONTHLY
APRIL, 1936

SHORT CUTS IN DOING SQUARE-KNOT WORK

SQUARE-KNOT work can be done with greater ease and rapidity by observing the following suggestions:

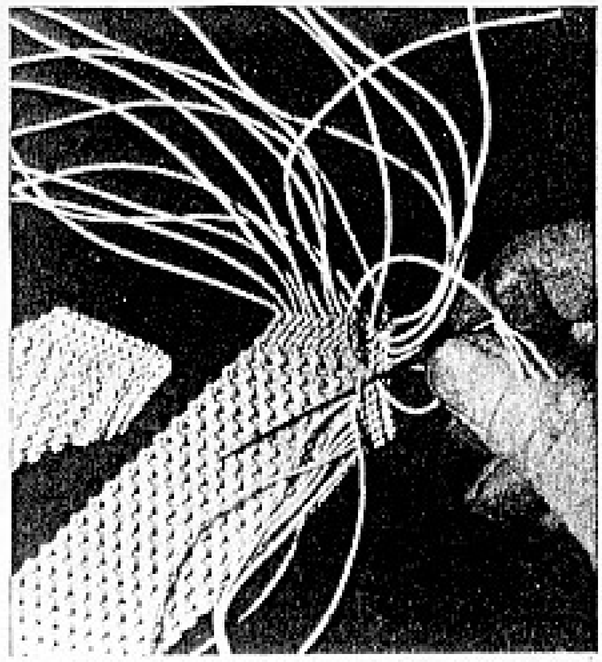
The cord is left by most workers as it is cut, but much time is wasted by having to pull the long cords through during the process of tying each knot. If the cords, after having been cut into the desired lengths, are chained with the chain stitch shown in the accompanying drawings, it will be found a great timesaver because this shortens the cords and prevents them from tangling. The loops should not be over 2 in. long, and after the cords are chained up as



Device for holding the ends of cords during the knotting, and a cord-shortening stitch

close to the work as desired, a half hitch is placed over the top of the last loop and drawn tight.

The knot-work board is made of 1-in. material (preferably hardwood) and has an adjustable clamp on top that may be changed to accommodate any size article. The board may



After the article has been finished with the usual half-hitches, the ends are sewn back

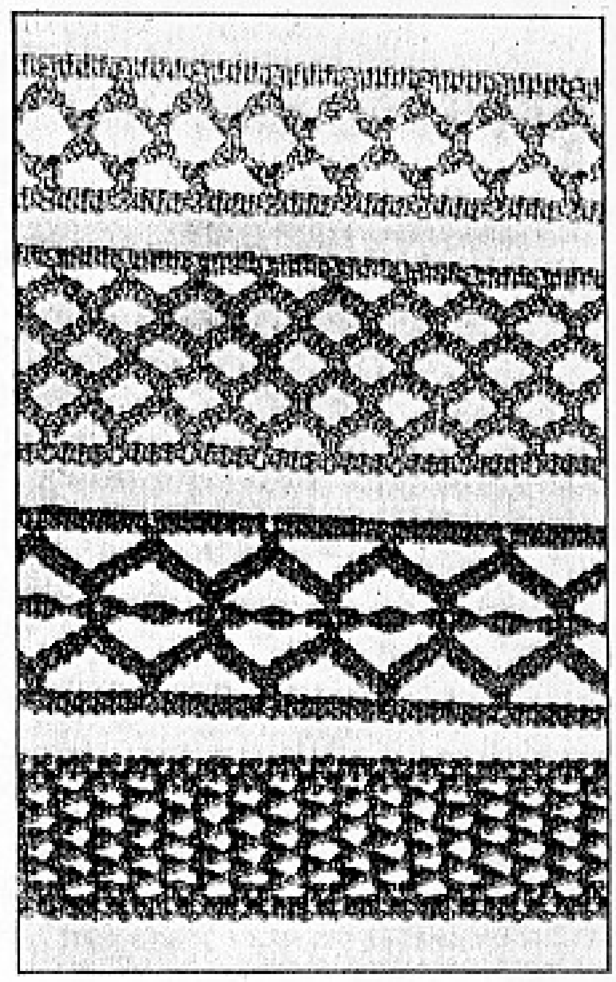
be held on the knees or placed on a chair, table, or any convenient place.

It does away with the laborious method of working from a cord attached between two nails, pushpins, or like devices.

A smoother and more lasting ending of an article may be had by using a large darning needle to sew the ends (after the end of the article has been finished with half-hitches) instead of using liquid cement to fasten them. The ends of the cord on belts and other articles subject to friction do not always hold when merely fastened with cement. Sewing will bind the ends of the cord securely.

When a belt is being finished, put on two or three rows of half-hitches, then thread the needle with the outside cord (the cords being used consecutively). Sew straight back from the end instead of across the belt, as this eliminates a bulge at the point caused by too many cords' coming together.

The sewing itself is done by pushing the threaded needle through the underside of the half-hitches as shown in one of the photographs, after which the ends may be cut off.



Belt patterns to illustrate the variety of designs that can be made by square knotting

If the cord has a tendency to shrink, the belt may first be washed by using a small brush with soap (soap flakes preferred) and water. After it has dried, the ends are cut off with a razor blade or a sharp knife.

The same method is used on any knot-work article where half-hitches are used and on many articles not ending in this manner. Sewing should preferably be done under two strands of cord, although one strand is sometimes sufficient. It gives a smooth, neat, and lasting end.

The four designs for belts shown in the illustration above may be of interest to knot workers and serve as suggestions for making original patterns.—NEALON VOTAW.

Continued from page 1928

fluidity, and fills the mould in its finest details.

DURATION OF VISION.

Professor Ogden N. Rood, of Columbia College, in a late number of *Silliman's Journal*, has an article upon the amount of time necessary for vision, and refers to an experiment of Wheatstone's, which seems to show that distinct vision is possible in a period of less than one-millionth of a second. He, however, refers to experiments of his own, by which electric sparks were produced whose duration was only the forty-billionth part of a second; and yet, during their continuance, the letters on a printed page were plainly to be seen; and in polariscope observations the cross and rings around the axis of crystals could be appreciated, with all their peculiarities. He thinks, however, that while this period is sufficient for the production of a strong and distinct impression upon the retina, a smaller interval will suffice for many purposes, and that four-billionths of a second, and, perhaps, even a shorter time, may be sufficient. This, according to the professor, is not so wonderful, if we accept the doctrine of the undulatory theory of light; as, according to it, in four-billionths of a second nearly two and a half millions of the mean undulations of light reach and act upon the eye.

ASEPTIN.

A substance called *aseptin* has recently been introduced into trade by a Swedish dealer as a preservative material for milk, meat, etc. This is said to be simply boracic acid, or borax; the double aseptin consisting of two parts of borax to one part of alum. Putrefaction is said to be prevented by the addition of this preparation, but mouldiness in animal substances is not. Although a very short time has elapsed since aseptin has been brought into notice, thousands of pounds are now sold almost daily in Scandinavia and Germany.

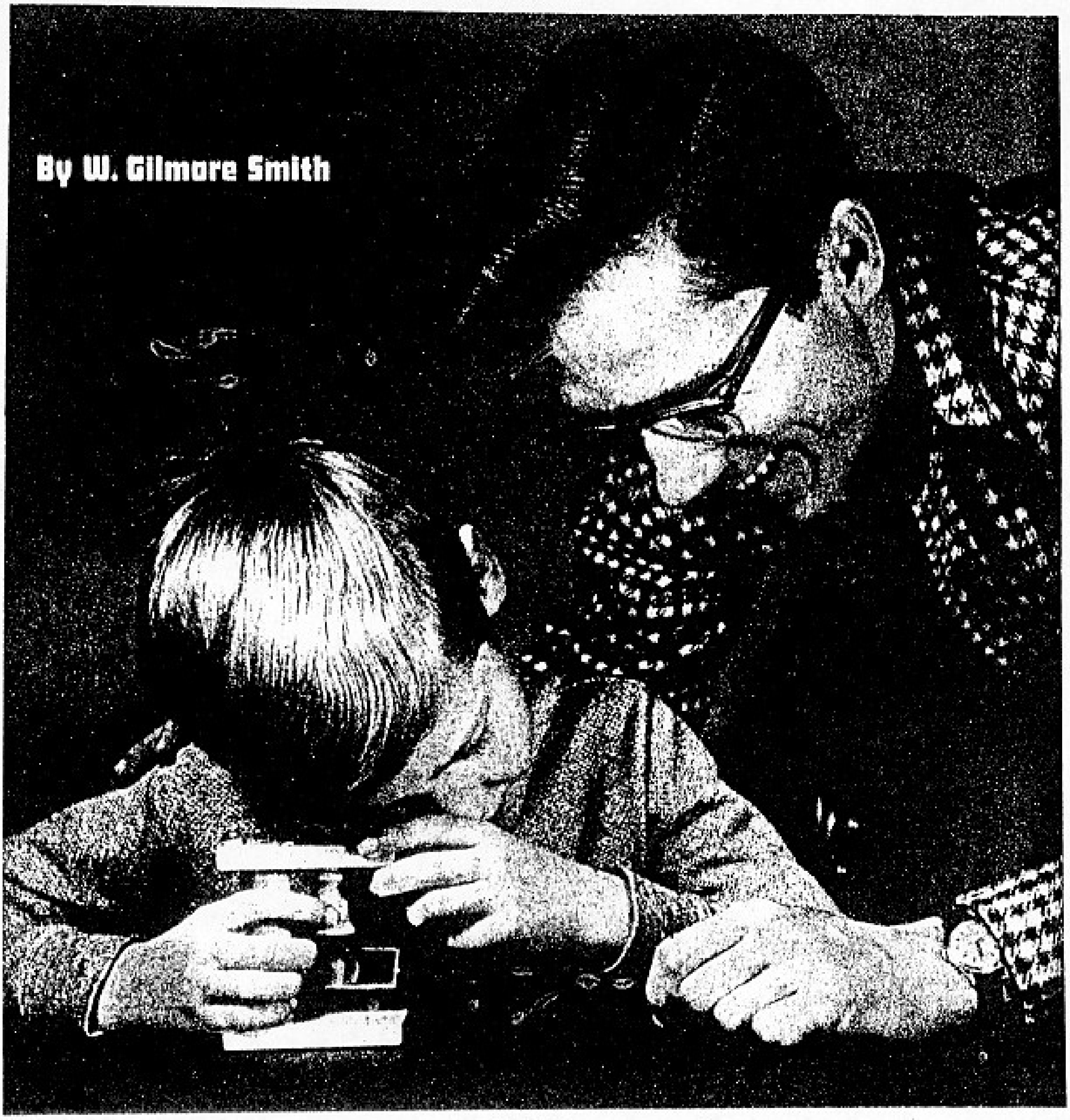
ELECTROPLATING METAL WITH NICKEL AND COBALT.

A process devised by Mr. Nagel, of Hamburg, for coating iron, steel, and other oxidizable metals with an electro deposit of nickel or cobalt consists in taking 400 parts, by weight, of pure sulphate of the protoxide of nickel by crystallization, and 200 parts, by weight, of pure ammonia, so as to form a double salt, which is then dissolved in 6000 parts of distilled water, and 1200 parts of ammoniacal solution, of the specific gravity of 0.909, added. The electro deposit is effected by an ordinary galvanic current, using a platinum positive pole, the solution being heated to about 100° Fahrenheit. The strength of the galvanic current is regulated according to the number of objects to be coated. For coating with cobalt, 138 parts, by weight, of pure sulphate of cobalt are combined with 69 parts of pure ammonia, to form a double salt, which is then dissolved in 1000 parts of distilled water, and 120 parts of ammoniacal solution, of the same specific gravity as before, are added. The process of deposition with cobalt is the same as with nickel.

ANALYSIS OF METEORIC SAND.

A meteoric sand which accompanied a heavy rain storm in Sicily, on the 9th of March, 1872, has been reported upon by Silvestri, who states that the sand strained out from the water consisted of about 75 per cent. of a clayey substance, colored yellow by oxide of iron, 11 per cent. of carbonate of lime, and about 14 per cent. of organic matter. In this the microscope revealed numerous vegetable fragments, such as hairs of plants, membrane, scales, seeds, etc., with various diatoms and living infusoria, while the water contained carbonate of lime, carbonate of magnesia, carbonate of iron, sulphate of lime, chloride of potassium, sulphate of soda, etc.

Continued on page 2255



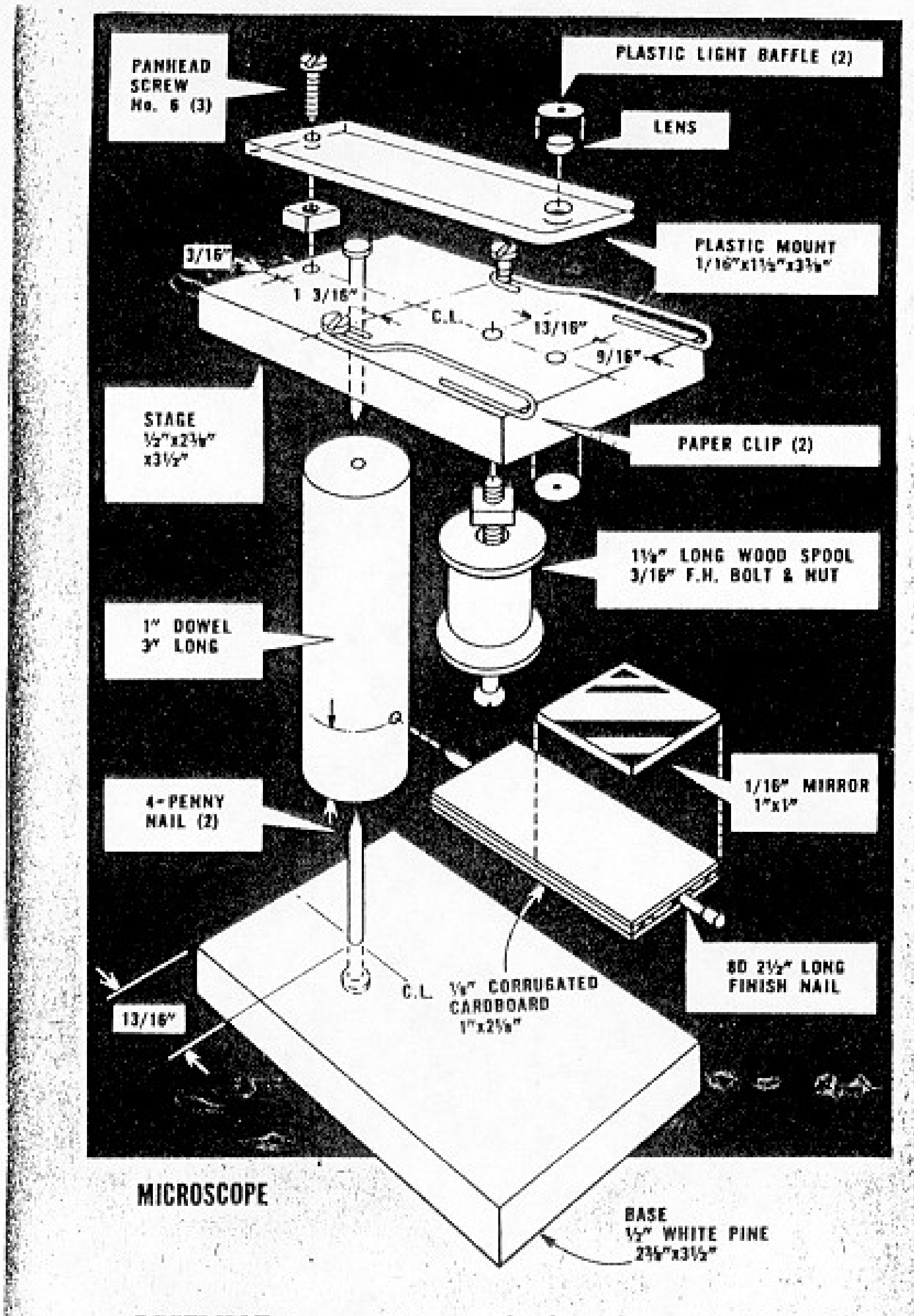
Mechanix Illustrated October, 1968

A Microscope for a Dollar!

ASIDE from being fun, a microscope sharpens a child's interest in nature and science. Father and son can build this 70-power microscope with less than a dollar's worth of wood, plastic and hardware scraps.

The lens is made from a No. 112 or 222 pen-light flashlight bulb. There is a solid glass bead at the tip of these bulbs that makes a perfect magnifier. Crush the bulb at the neck with a pair of pliers. Using the pliers or a file, remove the glass to within $\frac{1}{16}$ in. of the solid bead. Wear gloves for this entire operation.

This lens is glued into a ¼-in. hole drilled into a 1x3½-in. piece of plastic about $\frac{1}{16}$-in. thick. Use an old credit card or the edge of a plastic Band-Aid



ASSEMBLE stage and base with white glue and nails (below).

box. Two pieces of black plastic tape with $\frac{1}{16}$-in. holes pierced in them are placed on top of the lens and bottom of the stage to keep out stray light.

The plastic lens holder is screwed through a spacer nut into the back of the stage. In operation, the specimen to be viewed is held under the lens at the front of the stage by two paper clips. A 2¼-in. long bolt, attached to a wooden spool, is threaded through the stage just behind the lens. Turning the spool raises and lowers the lens for focusing. A small mirror, glued to a swiveling piece of cardboard, is used to direct light up through the lens.

To make construction even simpler, Mini-Scope Kits—designers of this microscope—will supply a basic parts kit for 60¢. The kit includes the lens holder, 70- and 100-power lenses, slide clips and an aluminum mirror. Their address is: 1622 Charmuth Rd., Lutherville, Md. 21093.

Once the microscope is completed, there are many fascinating things that can be observed. Specimens must be mounted on 1x3-in. clear glass or plastic slides. You can inspect insect wings, the granular structure of salt and sugar, or the microscopic animals that live in pond water. Hobby shops and surgical supply houses sell slides with mounted specimens. •

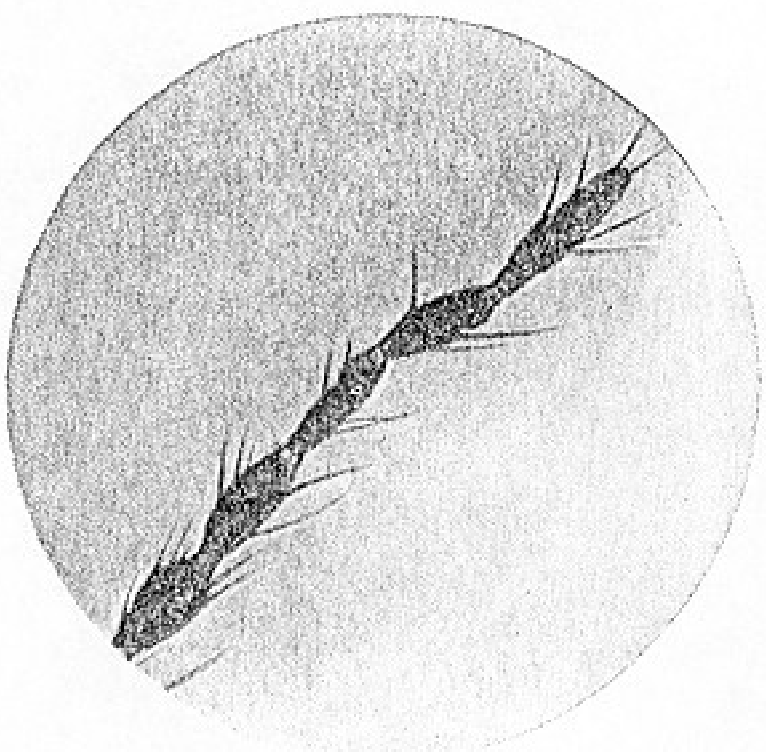
Photos by Morris Fradin

100-POWER

POPULAR MECHANICS 1954

You can build this powerful microscope at a cost of only a few cents for materials. It also serves as a polarizing microscope and can be used for taking photomicrographs. A single dry cell supplies the illumination

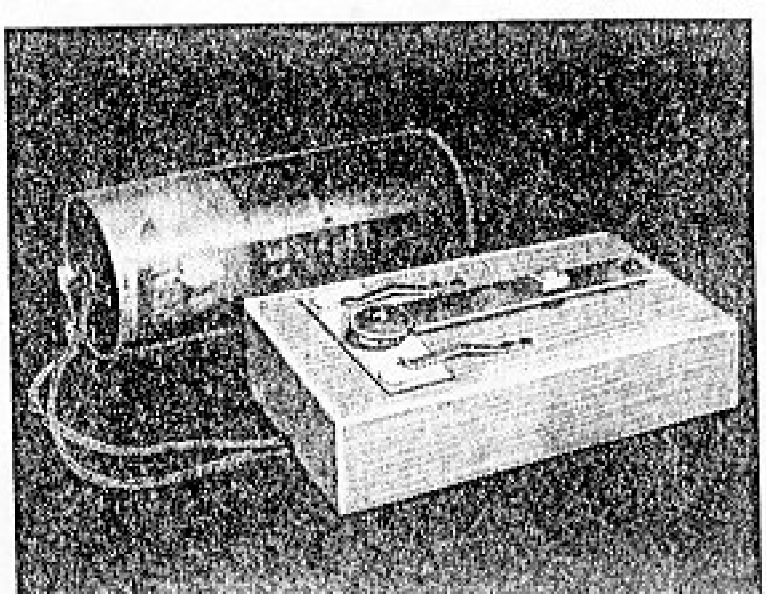
By William George Esmond



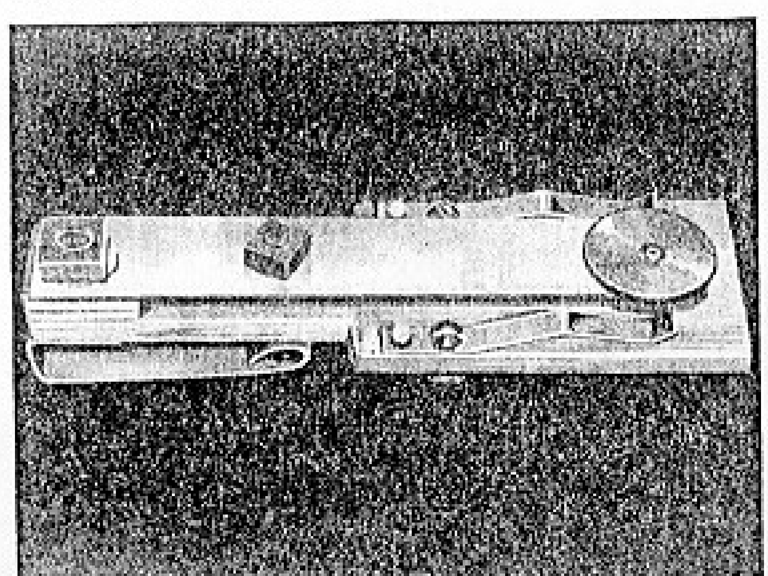
STUDENTS on summer field trips, amateur experimenters and others who must study the structure of minute objects, will find this microscope of novel construction and practical use. With a lens fashioned from the tiny bulb of a pen-type flashlight, it magnifies approximately 100 diameters. Using an eyepiece of 1-in. focal length, magnification up to 300 diameters is obtained. Although the resolving power of such a simplified optical system is limited, it does give sufficient definition for practical purposes and also for simple photomicrography, as proved by the sample photomicrograph of a mosquito antenna at the left. The microscope also can be made for use as a hand magnifier as in the right-hand photo below.

The first thing to do is separate the tiny lens from the pen-type flashlight bulb by breaking the bulb as in the lower left-hand detail on the opposite page. Then trim the excess glass from the bottom of the lens by breaking away small pieces with pliers. Be careful not to scratch the surface of the lens. Now, drill a hole through the center of a disk of 1/16-in. sheet metal and

Illumination from an ordinary pen-type flashlight bulb is sufficient for ordinary work, a single dry cell furnishing ample current. Other light sources may be used



Pocket-size microscope, or hand magnifier, can be made by attaching lens mount and slide holders to a piece of 1/4-in. plywood. Handy for students in the field

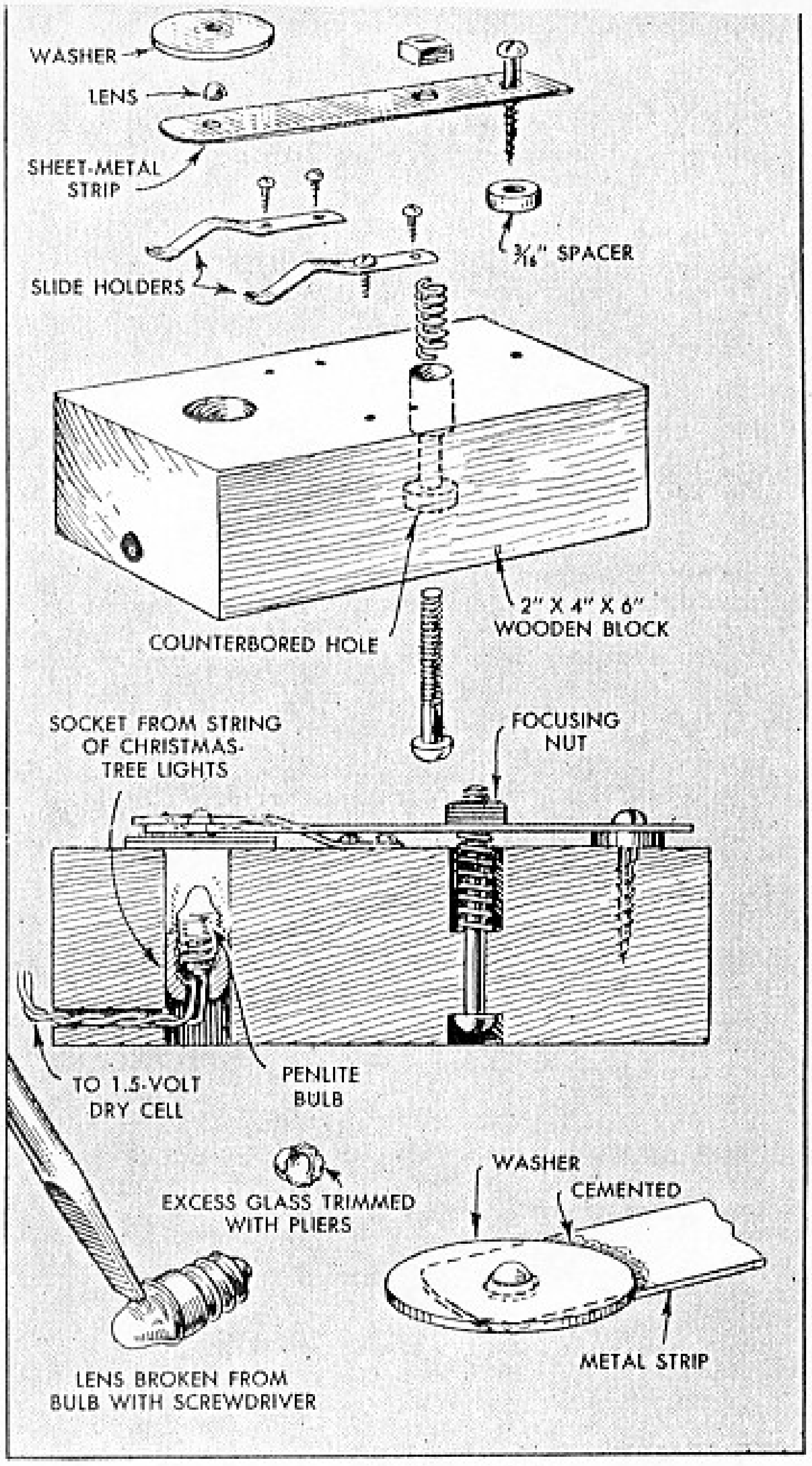


MICROSCOPE

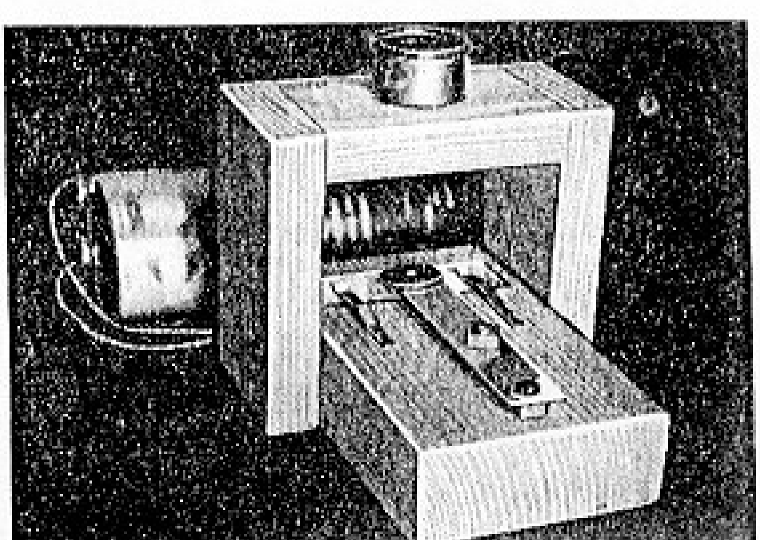
then ream the hole with a taper reamer so that the lens fits snugly with the bottom flush with the surface of the metal. Cement the lens in place with model-airplane cement. Then cement the disk to a ¾ x 5-in. metal strip as in the lower detail at the right. The lens must be centered over a hole drilled near the end of the metal strip, the hole being slightly larger than the diameter of the lens.

The manner of assembling the lens mount on a wooden base and providing a focusing adjustment is shown in the details at the right. The lens mount is anchored securely to the base with a round-headed screw driven through a hole drilled near the end of the metal strip. A 3/16-in. spacer is placed between the metal strip and the wood. A third hole is drilled through the strip about 1 in. from the screw to take a 3/16-in. stove bolt. The 3/16-in. hole through the wood is counterbored from both sides of the base as in the sectional view. The longer counterbore houses a coil spring which provides sufficient tension on the lens holder to hold it tightly against a focusing nut.

An ordinary microscope slide is used to hold the object under the lens. Slide holders, or hold-downs, are fitted on each side of the lens holder. Adequate lighting of the slides is accomplished by fitting a Christmas-tree lamp socket in a hole drilled through the base at a point directly under the lens and using a bulb from a pen-type flashlight. A single dry cell supplies ample current. The instrument can be made to serve as a polarizing microscope by placing a small square of Polaroid glass under the slide and mounting another over the lens to serve as an analyzer.

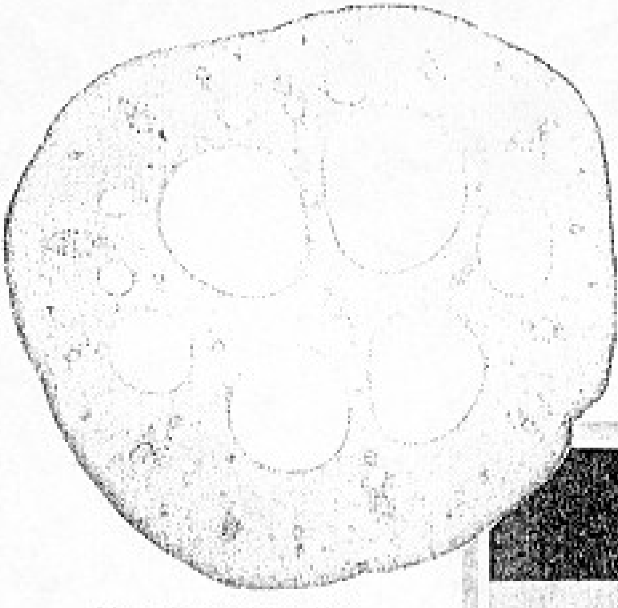


An eyepiece of 1-in. focal length mounted over the regular lens provides all the advantages of compound microscope. Gives magnifications up to 300 diameters



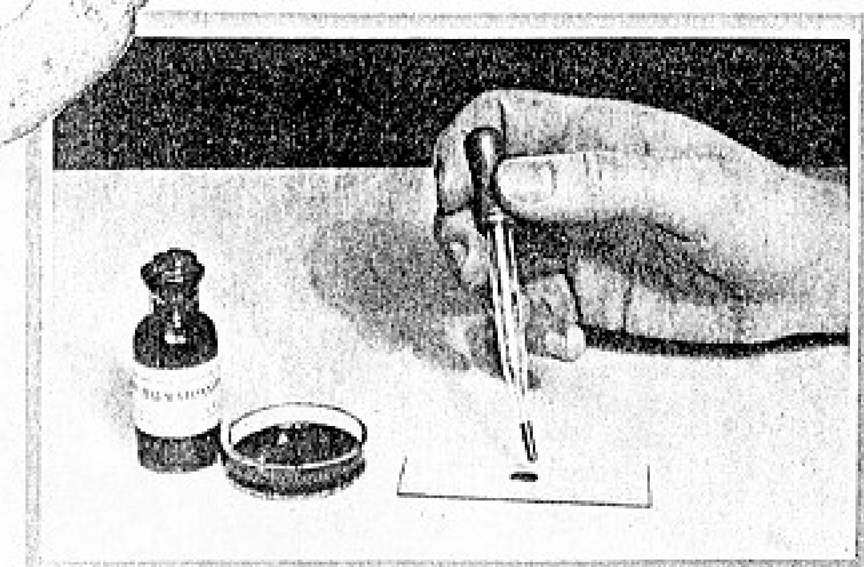
SECRETS of LIFE *revealed by your* Microscope

POPULAR SCIENCE MONTHLY
JUNE, 1933



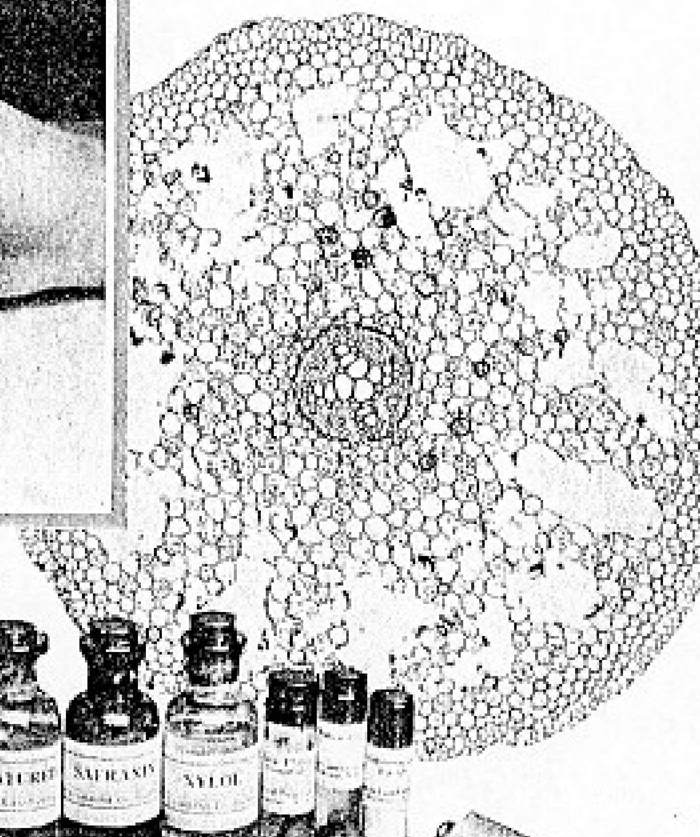
Photomicrograph by New York Biological Supply Co.

Cross section of pond lily stem, magnified nine times, from which a specimen can be cut



A quick way of staining specimens for immediate use is with a medicine dropper as shown. After the stain has soaked in, surplus around border is removed with blotter

Below, slice cut from the stem of a buttercup and magnified thirty times



Photomicrograph by New York Biological Supply Co.

This outfit contains stains, specimens, and special material. It can be bought for a few dollars

ALTHOUGH we have seen many wonderful things during our little journeys into the marvelous realm that lies beyond our sight, there is still much left to do, and a whole universe left to explore.

Even the little microscope we have been using, capable of magnifying only 300 diameters (that is, making objects appear 300 times their real size) opens a territory so vast that it would take us a hundred years to examine all of its strange details.

Hitherto we have been dealing with simple specimens that required little skill on our part. Now we are ready to take another and very important step. In the past, we were satisfied to study the surface of things, but henceforth we shall peer into their very insides. This new and exciting work will offer us a close-up of nature that can be obtained in no other way if we actually want to see it.

Let us take the opaque stem of a plant as an example. The real beauty of the stem is hidden from us, since to see it we must look inside where the cells are packed away and where the breath-taking craftsmanship of nature is on display. So what we shall need is a cross section of the stem cut so thin that light will pass through it. This we place under the microscope and see the real inside.

From certain specimens these thin slices may be cut with a new safety razor blade. To do this the specimen, gripped firmly between the thumb and index finger of the left hand, is held down on a piece of glass. Then with the razor blade in the other hand, a slice is cut off as thin as possible. Perhaps we shall have to cut a number of slices before we acquire the necessary skill; but if we are careful we shall be able to prepare some specimens in this crude way. In cutting, the blade is drawn across the stem, as a good barber uses a razor. Merely pressing down on the blade will crush the fibers and ruin the specimen.

To do this work more accurately and easily, we can build a handy little instrument that works very much as do the meat slicers in the butcher shops. It is called a microtome.

To make it, we need a piece of heavy brass tubing with at least a quarter-inch bore. The size of the bore will determine the diameter of the specimens that may be cut. In no case will a bore of more than one-half inch be needed.

Into one end of the tube fit a brass plug and solder it in place. Through the center of this plug drill a hole with a No. 29 drill. Then with an 8-32 tap, turn threads in this hole and fit it with a brass screw.

The little table which is soldered to the opposite end of the tube is of sheet brass, heavy gage, and as flat as possible. A piece of brass rod that forms a sliding fit inside the tube completes this useful little instrument. With a good sharp razor blade at hand, your microtome is ready for use.

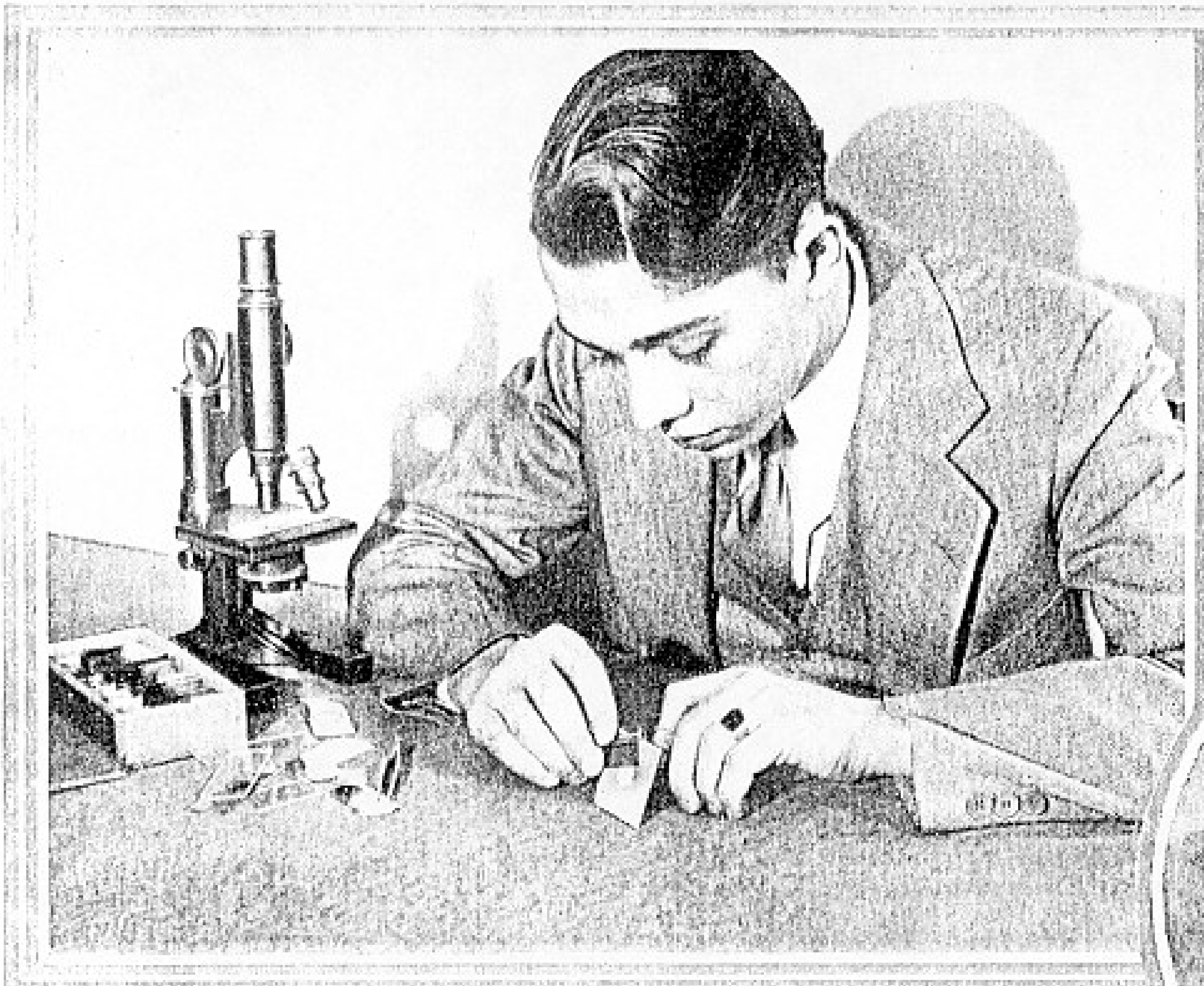
In using it, a specimen is placed inside the tube. As each slice is cut, the screw at the base of the instrument is turned slightly so the inside rod will push the specimen forward a tiny fraction of an inch. The cutting is done with the razor blade held close to the surface of the little table in the manner illustrated. By the proper manipulation of the screw, sections can be cut only a few thousandths of an inch in thickness.

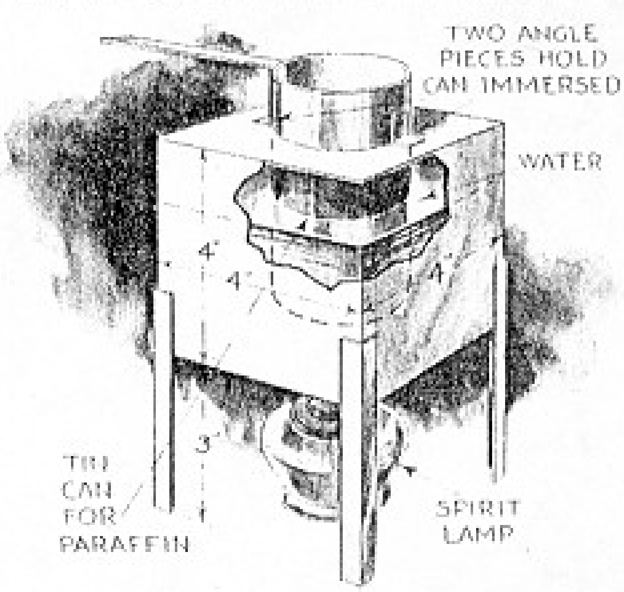
Merely to jam a specimen into the microtome in the manner described, however, would be the method of an amateur. The professional first puts wax around his specimen so that, while the cutting is being done, it will not be damaged by pressure or squeezing. The delicate stem of an iris, for instance, could not be cut without first embedding it in wax. Indeed, every biological specimen is thus prepared.

How Specimens of Living Things Are Cut into Thin Slices with Microtome, Mounted on Glass Slide, and Then Stained Is Told Here in Detail

By

BORDEN HALL





Drawing shows how to build heater in which the paraffin is melted without raising its temperature so high it will damage specimen

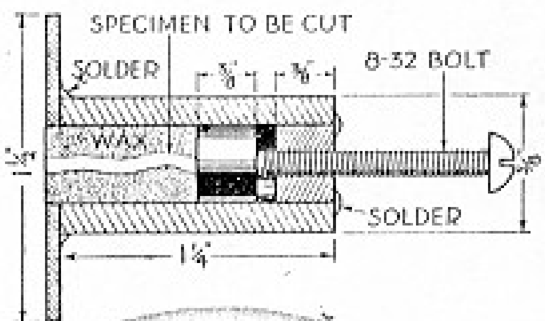
After the specimen has been mounted in place by pouring melted paraffin around it, the portion protruding from the end of the brass tube is cut off flush with the table. Then the screw at the bottom of the tube is given a small fraction of a turn and another cut is made. The first cut was simply to level off the end while the second cut provides the specimen. However, if you obtain a perfect slice on the second cut, you will be lucky. Generally, you will find it necessary to make several cuts before you are able to make really thin slices.

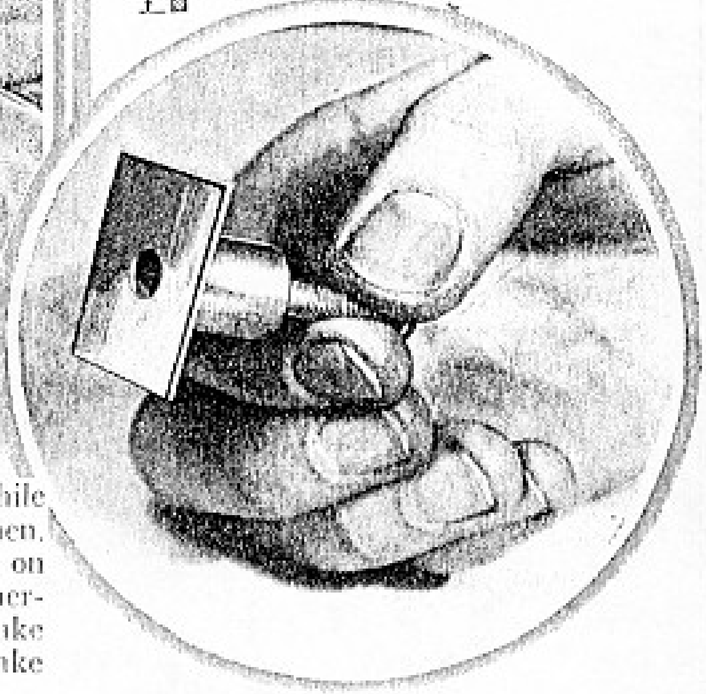
After skill is developed at this work and nice, thin slices are made, they may be slipped onto a glass slide and brought to the stage of the microscope without actually touching them with your hands.

Another point to be borne in mind in this work is that the paraffin used must not be too hot. If it is, it will tend to boil the water in the cells of delicate specimens and destroy their beauty. To overcome this, we build the paraffin heater shown in the drawing. The use of this little device will prevent the paraffin from heating above the boiling point of water and it will also be good insurance against fires. Also this pot will keep the paraffin warm for a long period of time. In preparing a specimen, it is dipped into the molten wax before it is placed in the microtome and embedded. An alcohol burner keeps the wafer hot under the wax.

Unfortunately some specimens require further preparation before they are ready for the little meat slicer. Thick, woody sections must be soaked for several days in clean water to make them pliable. When the sections are being cut, it is advisable to dip the edge of the razor in alcohol. Of course, if stems containing resinous matter are used, the soaking will be of little help as resin is not soluble in water. In such cases, we leave the specimen in alcohol for a day or two to dissolve the resin. Then it is placed in water for three more days. In a few cases, it will be necessary to boil the stems in water. In the case of material like the branch of a tree,

At left, the proper manner of cutting slices from a specimen with the microtome is illustrated. Below, line drawing shows how to make a microtome and, in circle, photo of completed microtome with adjusting screw in place





this process softens the fiber and makes the cutting of specimen slices much easier.

As we become skillful in the preparation of specimens, we shall eventually make slices so thin and so nearly transparent, that there will be little left to look at. Hence it becomes necessary to learn how to stain our specimen. A crude analogy will help us understand the reason for using stains. Under certain conditions of light, we are unable to see a piece of glass, a fact that is made use of by magicians in preparing stage illusions. However, if the glass were colored, we should not be so easily fooled. We use stains for the purpose of seeing and to reveal details of structure that would otherwise be invisible.

The kind of specimens we are considering at the moment, however, must be

bleached before the stain is applied. This is done by dissolving one ounce of chloride of lime in ten ounces of water. A second solution is made with two ounces of washing soda dissolved in water. The two solutions are then poured together and thoroughly shaken. After standing for a day or two, the solution is filtered and put in well corked bottles.

To bleach a specimen, it is immersed in the bleaching solution for a period of several hours. In removing it, remember the soaking has made it fragile and care must be taken not to crush it. Once out of the bleach, it is necessary to wash the specimen in several changes of water.

The stains to be used should be obtained from a biological supply house. Although the amateur has a large number of them to choose from, perhaps none is better for the beginner than hæmatoxylin, a red stain prepared from logwood. In using it, a watch glass is filled with distilled water and about fifteen drops of the hæmatoxylin is added. The specimen is immersed in this preparation and permitted to remain there for about thirty minutes. Then it is again washed in water and finally dehydrated by soaking it in alcohol for a few minutes. It is then transferred to a turpentine bath, after which it is mounted with Canada balsam on a glass slide.

When we place such a specimen under our microscope, we shall be amazed at the transformation that has occurred. In the place of the thin, shadowy outline that was first seen, we shall have a clear view of the specimen and all of its intricate and delicate details.

YOU are now ready to appreciate the wonderful methods used by industrial microscopic research workers who so treat an object that a view may be had of an entire body. If a trained microscopist wished to study the whole interior of a fly, he would not embed it in wax as we did and hack a piece off with the microtome. First he would freeze the fly solid so that its viscera would hold their shape while the thin pieces were being cut. The freezing would be done with ether spray and the cutting done on either a Rutherford or Cathcart slicer, which would cut the pieces to almost unbelievable thinness.

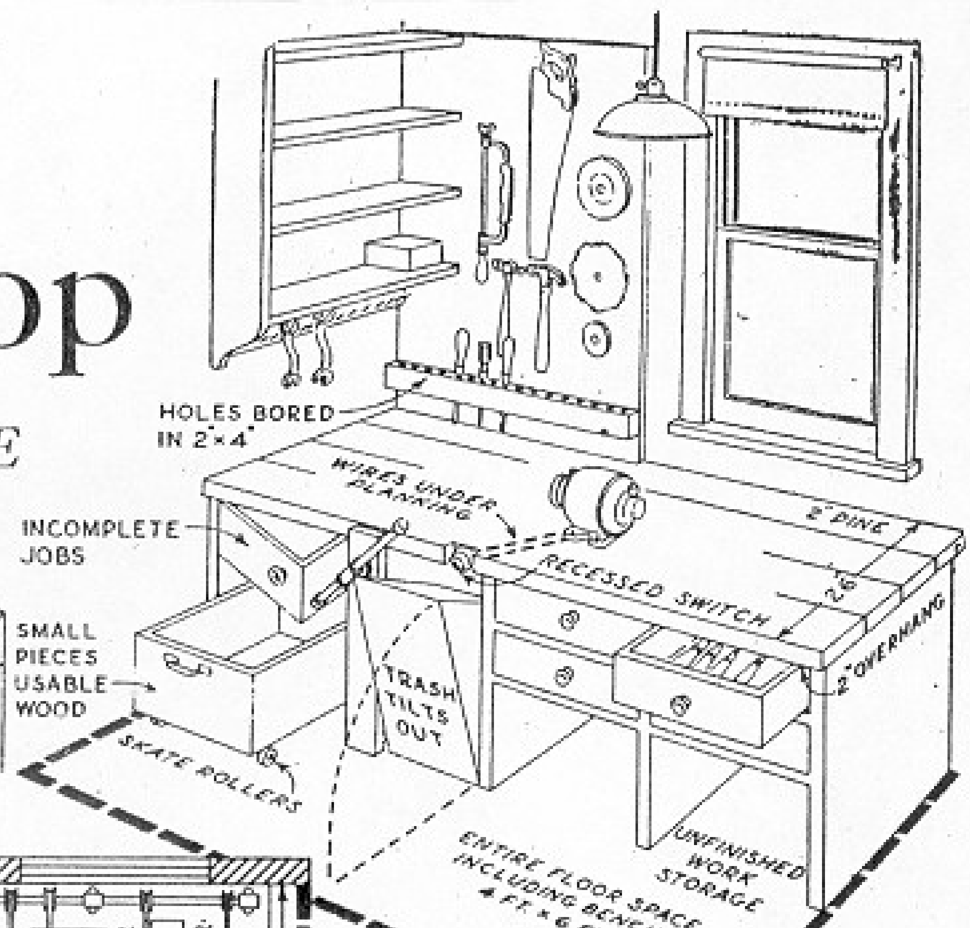
The scientist would not cut these sections of the body here and there at random. Instead he would start at one end and cut sections progressively all the way along the fly's body. Then he would mount the slices, starting with number one and working back through several hundred until he has seen the organs he wished to study.

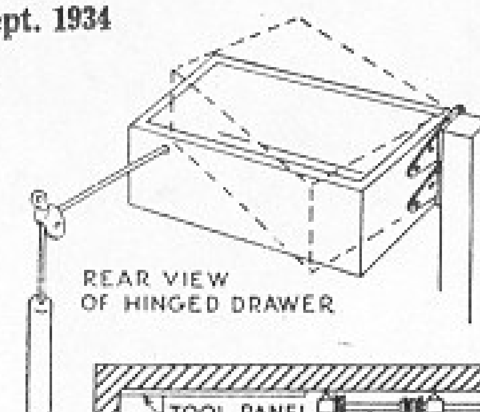
There is in use today an automatic microtome that will cut a bug, or any other organism, into a continuous series of sections that are later mounted and from which may be learned the story of the bug's mechanism.

Laying Out a Workshop

IN LIMITED SPACE

Popular Science Monthly — Sept. 1934



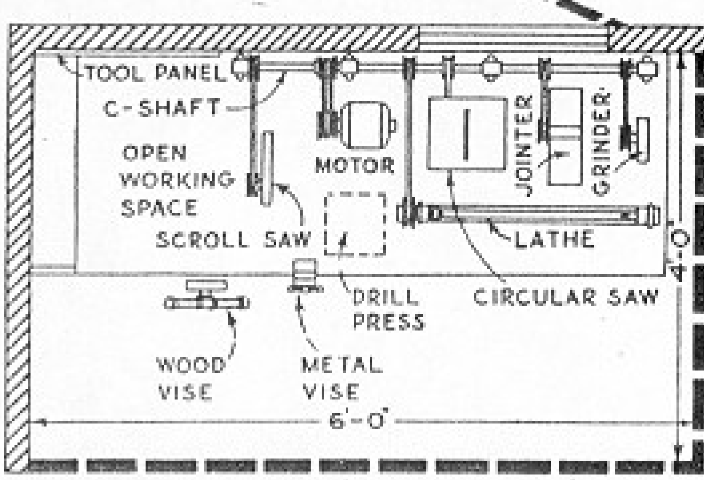


Bench with space for small motorized home workshop outfit in which the separate units are driven by one motor and a countershaft

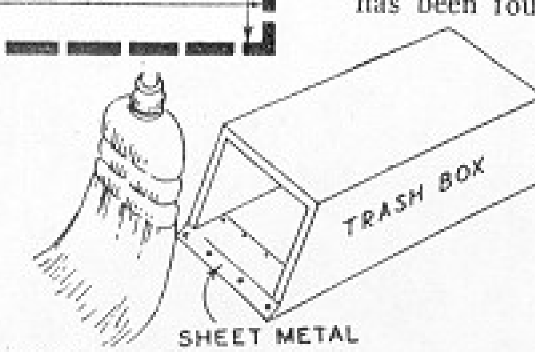
EVEN if you have only a small corner about 4 by 6 ft. in a spare room, screened porch, woodshed, cellar, or attic, you can lay out a satisfactory workshop with machines of the smaller sizes. A porch, if available, can be inclosed with wood wainscoting and glass windows obtained from a wrecking yard. It can then be comfortably heated with a so-called "hot-air" stove, which burns paper, shavings, odds and ends of wood, or coal. A new one can be bought for less than $2. Only as a last resort should an attic be used for your shop.

The accompanying plan shows the arrangement of one of the popular complete workshop outfits having one motor and countershaft—a small, moderately priced outfit. All the units can be arranged in a compact space. The bench should be about 34 in. high, or whatever measurement suits the height of the user.

In another drawing is shown the arrangement of shelves and drawers, and a tool panel on the wall. Small parts are kept in glass jars, heavier ones in boxes. In the ten-cent stores a handy three-compartment box can be purchased and labeled on the end, or one of the parts kept in each compartment can be wired on the outside instead of a label.



Plan of a 4 by 6 ft. shop designed to take a standard small outfit of woodworking machines with a drill press added. Details are given of a hinged drawer and trash box



A swinging drawer, installed as shown, has been found a great convenience. Below this drawer is a large box on skate rollers that can be pulled out easily, giving access to a stock of short pieces of wood.

The tilting trash box illustrated is another handy accessory, because it can be laid flat on the floor like a huge dust pan and the shop litter swept into it over the lip.

 THE SURVIVOR Vol. 5

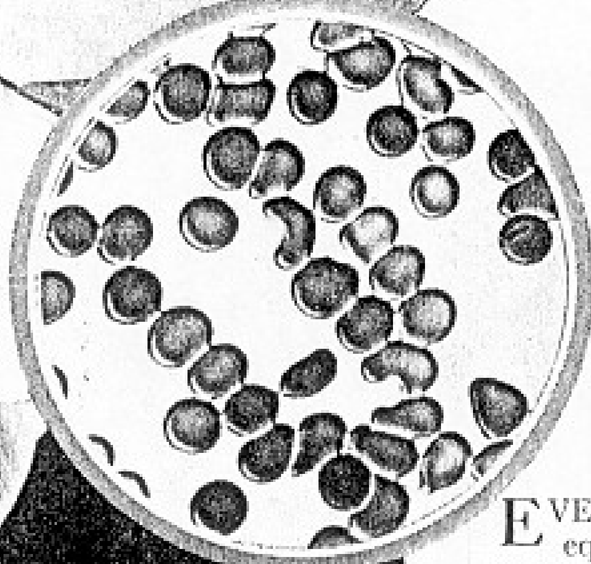
Answers to Common Microscope Problems

By Morton C. Walling

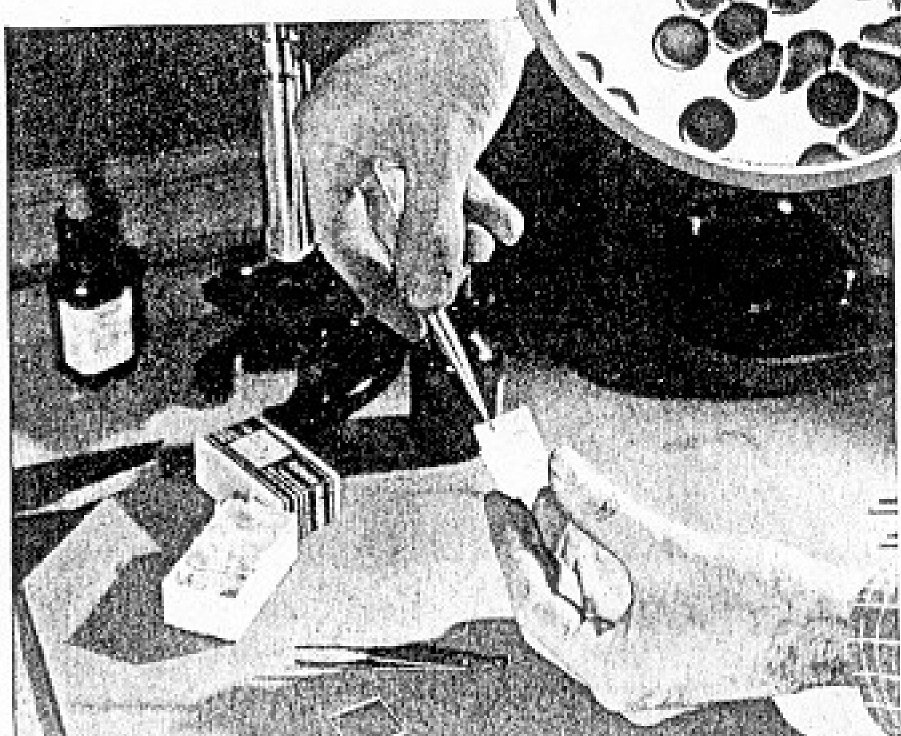
Here Are Some Questions That Fans Keep On Asking About This Fascinating Hobby. Maybe You Will Find One of Your Own Pet Queries on These Pages

POPULAR SCIENCE MONTHLY
OCTOBER, 1936

Equipment, supplies, and accessories for an amateur microscope laboratory. As the beginner progresses, he will form ideas of his own as to new items to add to his collection



Right, human blood corpuscles, mostly red ones, as seen under the microscope



To make a slide of blood, a drop can be spread into a film by placing it on a cover glass and sliding another glass over it as shown above

DURING the three years that I have been writing the microscopy articles I have received hundreds of letters from readers asking questions about microscopes and microscope technique. Although these queries cover a wide range of subjects, there is a small group that crop up again and again. Feeling that these are the typical questions that the average amateur microscopist is likely to ask, I decided that it would be a good idea to pass them along together with their answers.

And now for the first question:

I would like to start a microscope laboratory of my own. What equipment should a complete amateur laboratory contain?

EVERY amateur microscopist has his own ideas about the equipment he should possess. However, it is possible to mention a number of items that will be found useful and, in some cases, indispensable. Here they are:

Instruments and glassware: Several small, wide-mouth specimen bottles, with screw caps or corks. One or two wide-mouth glass jars, tumblers, or beakers. A pair of slender-nosed tweezers, preferably of brass or stainless steel. One or more ordinary medicine droppers, with slender or pointed tips. A small, round artist's brush. A pair of shears, such as nail shears. Scalpel or razor blade in holder, for dissecting specimens. A ten-inch piece of glass tubing, for use as a stirring rod and for dipping up small quantities of liquids. One or two saucers, shallow dishes, or watch glasses.

Supplies: A tube of filtered Canada balsam, for mounting specimens. Xylol (xylene), kept in a one-ounce dropper bottle, for dissolving balsam and fatty materials. Ethyl alcohol of various concentrations. You can keep a bottle of absolute alcohol on hand, and dilute it as required. Reagent-grade grain alcohol can be obtained at many drug stores, and denatured alcohol can also be used. Glycerin, pure, in a one-ounce dropper bottle. A one-ounce bottle of orange or white shellac. A one-ounce bottle of gold size, for sealing cover glasses on cells made with the shellac. Various staining solutions, including mercurochrome, iodine, methylene blue, eosin, and haematoxylin.

Other equipment: A quantity of one by three-inch glass slides. A half ounce or so of No. 2 cover glasses, square or round, twenty-two-millimeter diameter. An electric lamp (any type of desk lamp will do). And, of course, a microscope.

These items are among those considered essential by most experienced amateurs. Some can be dispensed with at first; and

there are others, such as color filters, that you may consider as necessary even at the beginning of your hobby.

How are permanent slides of blood made? What is the best way of examining human blood?

A SMALL drop of the blood of a frog, chicken, or any other animal can be made into a permanent preparation very quickly and simply. First spread the blood out into a very thin film. One way to do this is to let a drop fall on a clean slide and then, very quickly, draw the edge of a clean cover glass over it. Another method is to drop the blood on a clean cover glass, place a second cover glass over it, and then draw the two apart with a sliding motion, so that very thin films are left on each glass. The blood will dry very quickly.

Various stains can be used to color the blood cells. One of the best is Wright's stain, which can be purchased from dealers. Drop the stain on the dry film. A minute or so later add an equal quantity of water. Then, in another three or four minutes, drain off the water-stain mixture, and add clean water. When pinkish areas appear in the film, drain off the water, and let the film dry for several minutes. Then add a drop of Canada balsam, lay the cover glass in the center of a clean slide, and your preparation is completed.

Blood is particularly beautiful by dark-field illumination. If your microscope is not equipped with a dark-field attachment, you can produce the same effect by inserting a disk of cardboard, somewhat smaller than the substage mirror, between mirror and slide.

Use fresh blood. You can obtain a sample from your own finger. First wash the ball of the finger in a solution of ninety-five percent alcohol and two tenths of one percent mercuric chloride, and then puncture the skin with a needle sterilized in the same solution. A good place to obtain blood is from the middle finger of the left hand. Squeeze until a large drop of blood is obtained. Then touch this drop against a clean cover glass.

Lay the cover glass, blood side down, on a clean slide, and remove any blood that runs out at the edges. Cover the edges of the cover glass with oil—any heavy oil will do—to prevent evaporation.

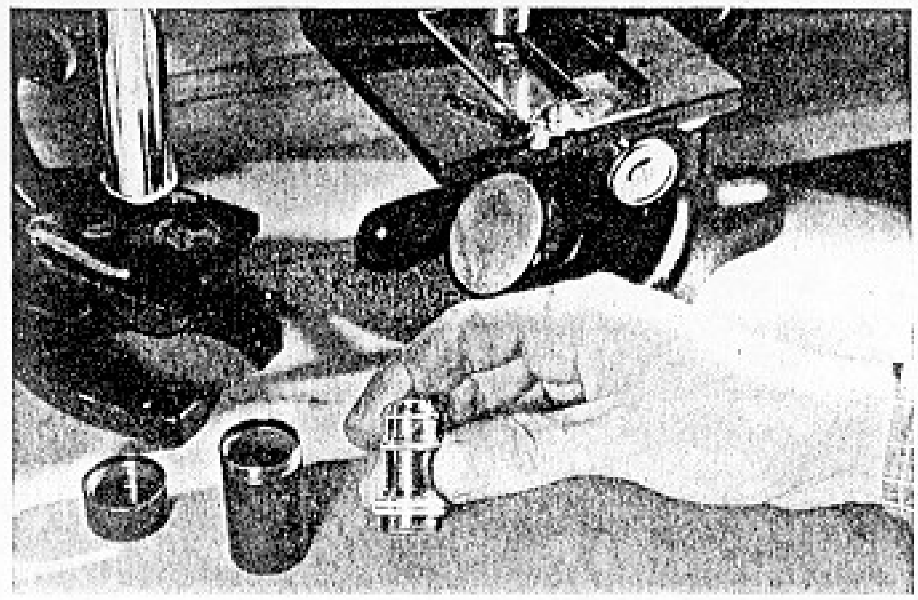
With dark-field illumination many interesting features of the blood are seen more strikingly. You may even be able to see the white corpuscles moving about like amoebas.

I have some balsam that I use to cement cover glasses in place, but it takes too long to dry. How can I treat it so that it will not be so thin?

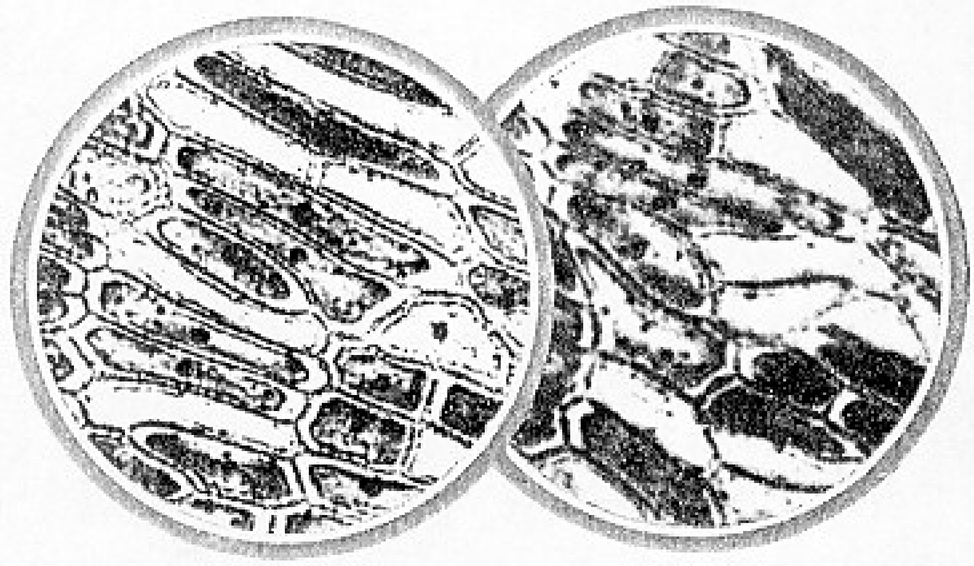
EVIDENTLY, the balsam has too much solvent in it. It can be made thicker by evaporating out some of the solvent. This can be done by warming a quantity of the balsam over an alcohol or gas flame, or in a water bath. A drop on a clean slide can be treated easily, when only a small quantity is needed. If the balsam is too thick, it can be thinned with xylol. Use only filtered balsam made specially for microscope work, if best results are desired.

I hear so much talk about oil-immersion lenses. What are they?

MICROSCOPE lenses are rated according to their resolving power, or the ability to separate fine lines or dots very close together. This power depends on, among other things, the index of refraction of the material between lens and object. With an ordinary or "dry" lens, the intervening ma-

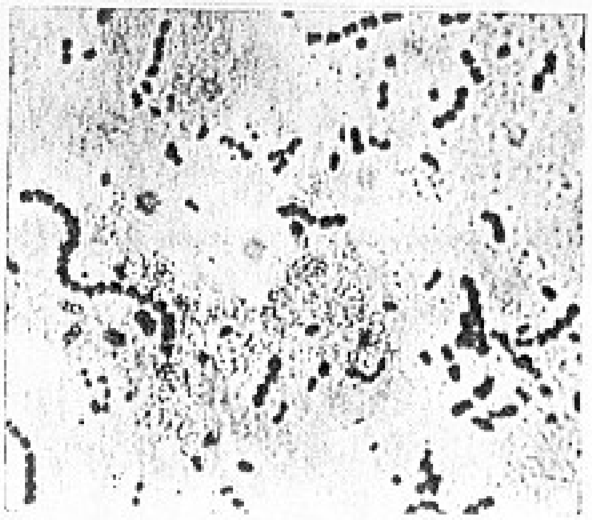


A typical oil-immersion objective lens of ninety-eight times magnification. It is made for use with the large microscope in the background

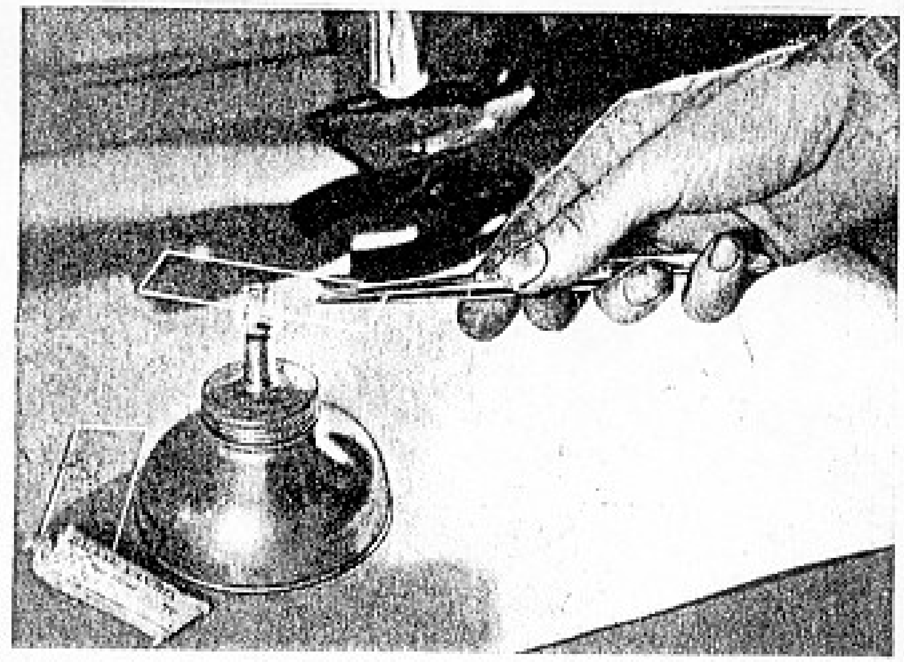


Cells of bean membrane as seen through the well-corrected lenses of a professional microscope (left) and through a cheap, "high-powered" set

Examining coffee for adulterants. Before making such tests, the microscopist must learn to recognize the food itself



Bacteria in buttermilk, stained with Loeffler's solution and magnified to 1,500 diameters



If Canada balsam is too thin for mounting specimens, it can be hardened by warming it over an alcohol or gas flame, or in a water bath

terial is air; and the resolving power therefore is limited by the refractive index of air.

If the refractive index of the material between objective and object can be increased, the resolving power of the lens becomes greater; that is, greater detail can be seen without increasing magnification. Also, the image becomes much brighter. The most common way of doing this is to place a material such as thickened cedar oil between lens and cover glass. The refractive index of this oil is the same as that of the glass used, so some of the rays of light, in traveling from a point in the object to the lens, are not refracted or bent outward so as to miss the objective, as they do when passing from the glass slide to air. Although cedar oil is the common immersion liquid, water and other liquids can be employed with lenses designed for them. The amateur should not worry very much if he has no oil-immersion objective, for he can do most of his observing with lower-powered, less costly lenses.

When an amateur buys a microscope costing not more than twenty dollars, which is more important, clearness of image or magnifying power?

CLEARNESS of image should be preferred always to high magnifying power, for the simple reason that a magnification of, say, 500 diameters is of little use if the image is so indistinct that the details cannot be seen. Size alone is not sufficient; the image must be reasonably sharp. The trouble with a great many microscopes offered for sale to amateurs is that their lowest magnifications are too high. A great many common objects, such as the eggs of insects, are seen better at a relatively low magnification of twenty or thirty diameters, than at 100 or more diameters. It has been said that perhaps seventy-five percent of all amateur observation can be done at magnifications of 100 diameters or less. Inexpensive microscopes, because of inherent faults in their lenses, produce less distinct images at high powers than at lower magnifications.

Can carbon tetrachloride be used for dehydrating specimens, instead of several baths of alcohol?

NO. CARBON tetrachloride does not enter into solution with water, and therefore cannot be used for extracting water from a specimen. Grain alcohol in various concentrations is employed almost universally for dehydrating. Water in the specimen enters into solution with the alcohol. Two such liquids tend to diffuse evenly through each other. Thus some of the water in, say, a section of plant stem, has to leave the stem when the specimen is placed in alcohol, in order to make this possible.

The routine of dehydrating with alcohol consists of leaving the specimen for successive periods in alcohol-water solutions of increasing strength, until finally absolute alcohol (that containing no water) is used. Concentrations and times of immersion vary with the kinds of material and sizes of the pieces. Thus a piece of plant tissue, previously fixed in chrom-acetic acid and washed, is left an hour in fifteen percent alcohol, an hour in twenty-five percent, two hours in thirty-five percent, two hours in fifty percent, and finally placed in seventy percent alcohol, where it can be preserved indefinitely. For complete dehydration, it is placed for an hour or two in eighty percent, ninety-five percent, and, finally, absolute alcohol.

How should a rank beginner go about focusing a microscope?

FOCUSING a microscope is not difficult; it is a simple operation that, once learned, is performed automatically, like lifting your feet when you walk. The greatest danger is that the objective lens will be pushed down against the slide so hard that the cover glass, and, perhaps, even the specimen and the lens, are damaged. The procedure followed by the careful microscopist, particularly for short-focus (high-power) objectives, is as follows: While looking at the side of the objective and the slide or specimen, lower the microscope tube until the objective tip almost touches the cover glass, or surface of the object if it is not mounted. Then, and only then, move your eye so that it is looking into the eyepiece. Now, by slowly moving the tube upward, bring the image into sharp focus. Once the approximate focal position is found, fine focusing can be done by moving the tube carefully in either direction. With larger microscopes, the fine adjustment always is used when focusing very near the cover glass, and when making minute adjustments at any position.

What important stains does the amateur need, and what are the formulas for them?

THE staining solutions required depend to a large extent on the type of work being done. However, for a start, the amateur can get along nicely with less than a half dozen. These might include:

Iodine: Use ordinary tincture of iodine, and dilute with five parts water or alcohol.

Mercurochrome: Use in the strength sold for antiseptic purposes, or dilute with water as required.

Eosin: This produces a red or pink color. Can be purchased as a tablet or powder, and dissolved in water or alcohol.

Methylene blue: This is one of the most useful of stains. Loeffler's solution is made by mixing thirty cubic centimeters of a saturated solution of methylene blue in alcohol, with 100 cubic centimeters of water to which has been added two drops of ten-percent solution of potassium hydroxide. (A teaspoon holds about 3.5 cubic centimeters, an ordinary drinking glass about 240.)

Haematoxylin: Solutions such as the Delafield haematoxylin stain are difficult to prepare properly, and are best purchased ready-mixed. Often used with eosin for staining animal tissue.

Acid fuchsine: Make a one-percent solution of the dry stain in water or alcohol.

Methyl green: Make a saturated solution in distilled water, or in one-percent acetic acid. Methyl green and acid fuchsine are used for double staining of botanical preparations. The specimen first is stained several hours with methyl green, washed, and then placed for a few minutes in the acid fuchsine solution.

There are a number of microscope supply houses which carry large assortments of microscope stains put up in one-ounce bottles, or in similarly small quantities. An ounce of almost any stain will last a surprisingly long time.

Can I see bacteria at 400 diameters with a microscope costing less than five dollars?

TO ANSWER this, it would be necessary first to examine the microscope. However, cheap microscopes generally are almost useless when it comes to revealing bacteria. Although the magnifying power may be there, the definition of the image is so poor that the observer does not know whether he is looking at a bacterium or a speck of dust. It is possible to see bacteria with amateur microscopes made by reliable companies and selling for as little as fifteen to thirty dollars, but considerable patience is required. Bacteria should be stained with a preparation such as Loeffler's methylene blue; sometimes the use

of a deep yellow or orange color filter will improve the image by increasing contrast.

Can a microscope be used to detect adulterants in ground coffee and other foods?

YES, indeed. The Board of Food and Drug Inspection of the U. S. Department of Agriculture maintains one of the finest microanalytical laboratories in the world, for detecting foreign materials in foods, and for analyzing drugs. To examine ground coffee, moderate power can be used. The coffee is examined without any particular preparation, by strewing some of it on a slide and looking at it. Among the adulterants that have been used are coffee chaff and rye cereal. Coffee sold by reliable companies contains no adulterants.

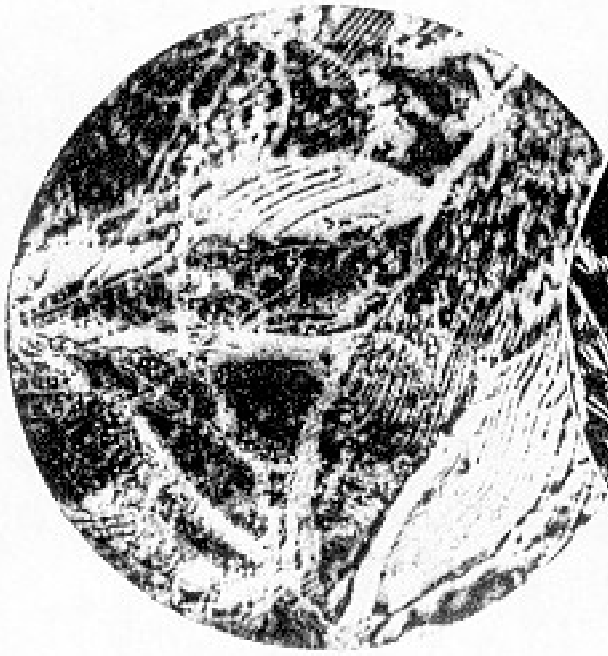
The microscopist who would detect foreign substances in his coffee or other food should first learn to identify positively the coffee or food itself—learn how it appears under all conditions. Thus the surface of a particle of crushed coffee bean has a characteristic appearance. After a microscopist has learned to identify the food itself, he is fairly certain to recognize adulterants present in any effective quantity.

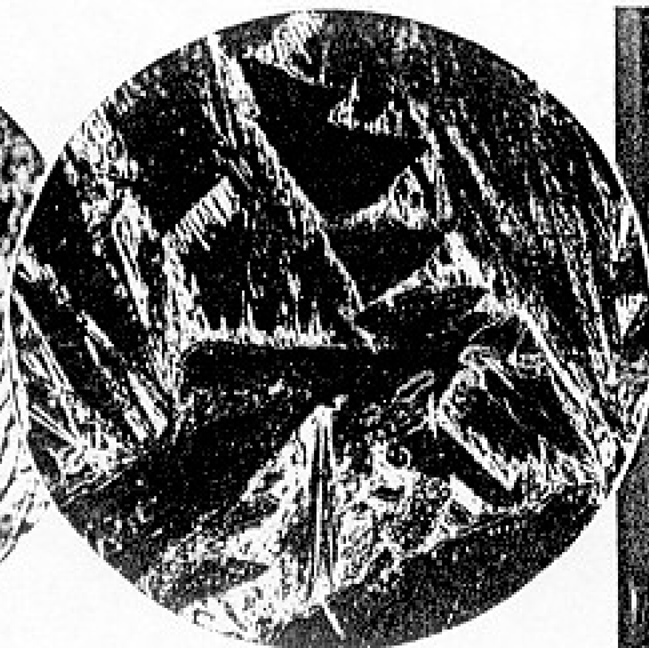
POPULAR SCIENCE MONTHLY
FEBRUARY, 1936

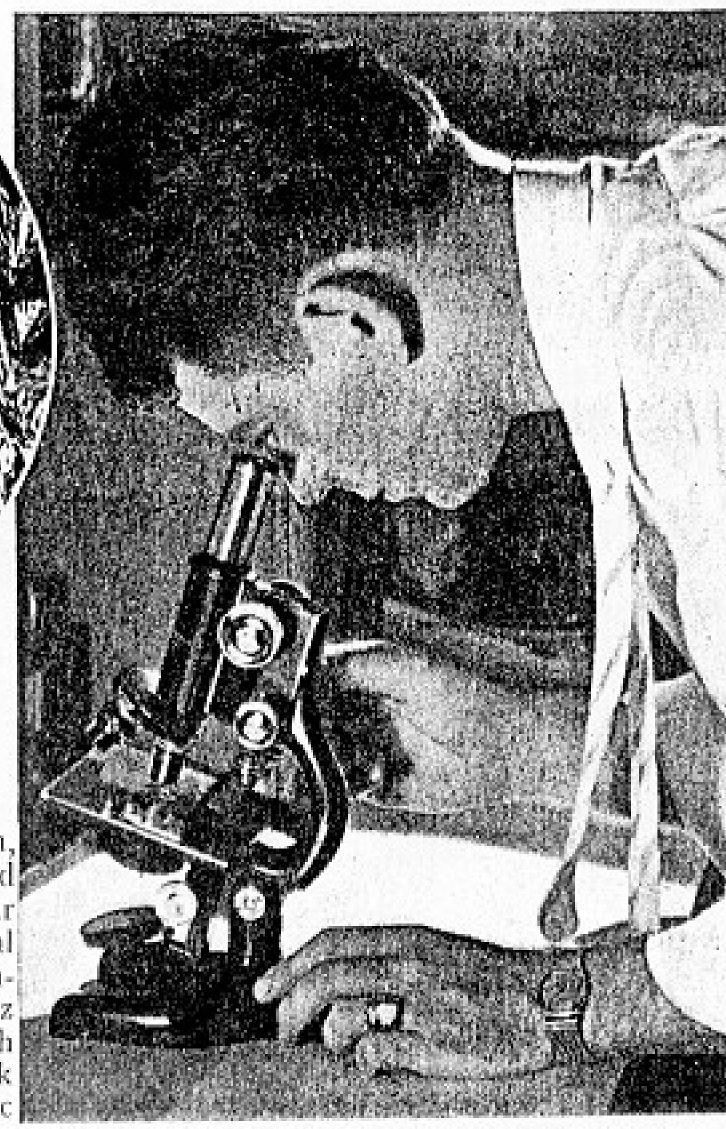
Strange Beauties of Crystals Revealed By Your Microscope

Tiny Particles of Common Household Chemicals, Viewed Through Your Magic Lenses, Present a Weird Wonderland for Exploration and Study

By Morton C. Walling







Crystals of two sulphates as seen through the microscope. At the left is magnesium sulphate (Epsom salts), and at the right, crystals of copper sulphate (blue vitriol). The photograph shows how the tilted microscope is used for watching crystals form

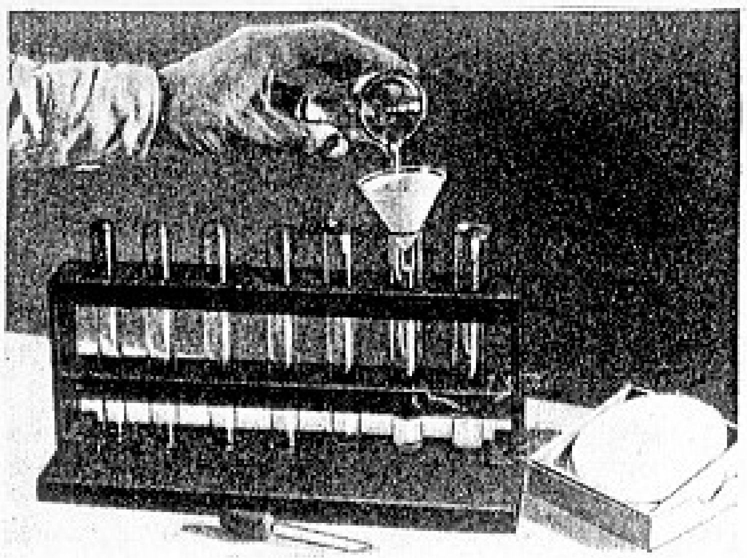
THIS is, in many respects, the age of crystals. The metallurgist, with his special microscopes, studies the crystalline structure of steels, and learns how to make better alloys. The microanalyst, by comparing minute crystals of a poison or a substance used to adulterate food, with known crystalline materials, is able to identify the undesirable ingredient. The science of microchemistry depends to a considerable extent upon knowledge of microscopic crystals. To the amateur microscopist, crystals have a special appeal because they are among the most interesting and beautiful objects upon which he can train his magic lenses.

A crystal is a piece of chemical element or compound whose surfaces are plane and arranged symmetrically. This arrangement is an outward expression of internal structure—in other words, of the manner in which atoms and molecules of the substance are placed. For convenience, crystals have been classified, according to their geometric form, into "systems." There are, for example, the hexagonal system, including such crystals as the elongated six-sided prisms of quartz; the regular system, represented by the octahedral (eight-sided) crystals of alum; the rhombic system, including sulphur and topaz crystals; the monoclinic system, of which gypsum crystals, tartaric acid, and rock candy are examples; the square prismatic system, with the mineral zircon as an example; and the trigonal system, with the scalenohedron crystal of calcite as an example.

But, without worrying about the countless possible crystalline forms, you can enjoy several evening sessions at your microscope, looking at crystals. The preparation of crystal specimens is so easy, and there are so many possible sources of interesting forms, that you need never want for an ample supply of varied materials.

From the kitchen table, borrow the salt shaker. Place a small pinch of salt on a clean glass slide, and add a few drops of water. Stir with a toothpick until the salt dissolves. Then warm the slide gently over a Bunsen burner, an alcohol lamp, or the small electric warmer whose construction is described later in this article. When the water begins to evaporate and a white deposit forms about the edge of the liquid, place the slide on the stage of your micro- [illegible], which has been tilted one or two [illegible]es from the horizontal. Focus at the [illegible] of the water film in the thinnest part of the water layer, and watch what happens!

You will see, here and there over the microscope field, tiny cubes that increase fairly rapidly in size. There may be groups of cubes that grow into masses resembling modernistic buildings. These cubical



1 To prepare crystals of chemical salts for study under the microscope, make a saturated solution and filter it to remove dirt, lint, and other impurities

2 Place a drop of the filtered solution on a clean slide ready for evaporation into its crystals

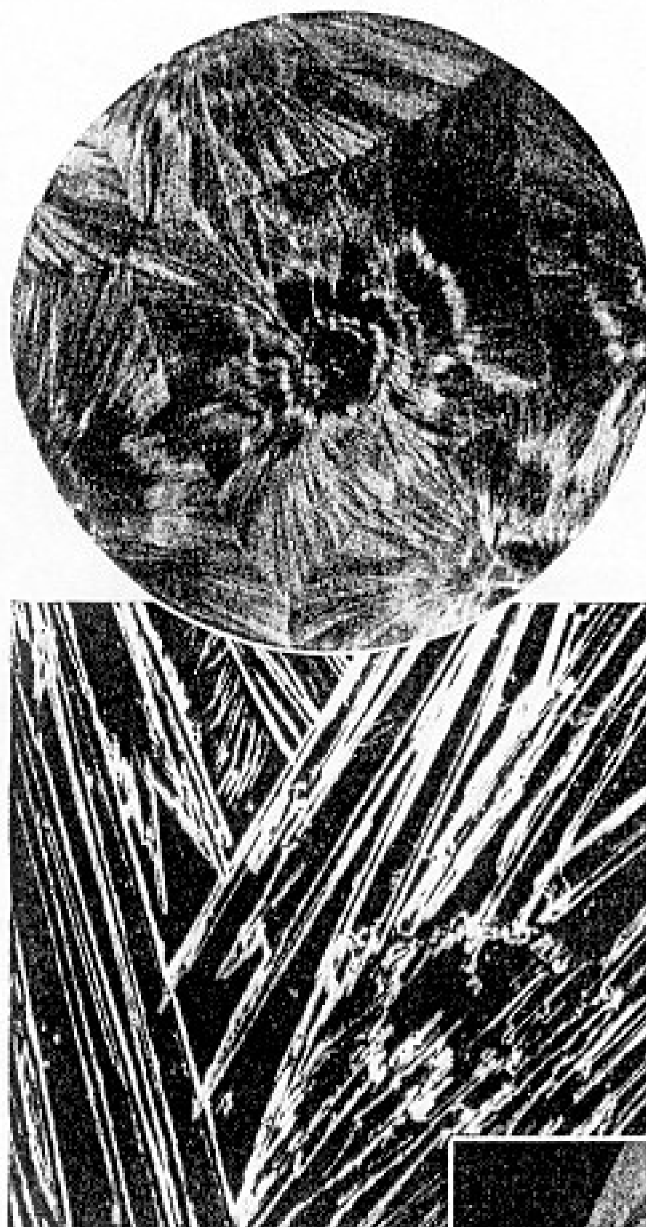
objects are crystals of sodium chloride—common salt. Scattered among them you may observe crystals that are not cubical in shape but which may have complex, many-sided forms. These are crystals of other materials, perhaps some iodine salts, that were present in the table salt.

By this simple method, you can prepare slides of hundreds of different water-soluble crystalline substances. The process almost invariably consists of making a saturated, or at least a strong, solution of the material either by adding a few drops of water to some of it on a clean slide, or by dissolving as much as possible in a small quantity of water, and then allowing some of the solution to evaporate and deposit crystals. Heat is applied mainly to hasten the process of evaporation.

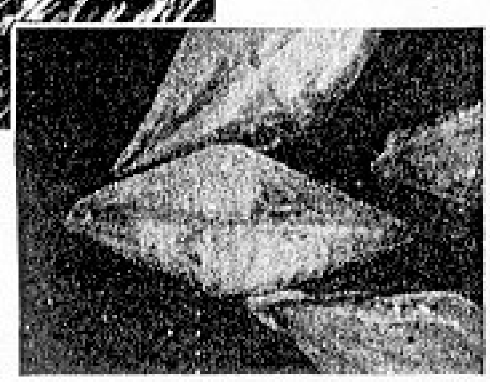
After you tire of looking at isolated crystals, try mixing two chemical salts together in solution, and letting the resulting liquid evaporate on a slide. Two excellent materials for this stunt are the sulphates of copper and magnesium. Make a saturated solution of copper sulphate (blue vitriol), and of magnesium sulphate (Epsom salts). Mix a drop of each solution together on a glass slide and heat to a fairly high temperature. The salts will fuse in their water of crystallization. Do not carry the heating too far. Stop when the material has formed a clear film on the hot glass.

Transfer the warm slide to the microscope, and focus on the film. Adjust the illumination so that the light is not too strong; or, better still, employ dark-field illumination if your microscope is equipped for that. As the film cools, you will see little points appear and spread out in a beautiful pattern. You often can start these points by touching the film with the point of a needle. The growing patterns eventually run into each other, at which time growth stops. The result is a crystalline mosaic that is best seen at fifteen or twenty diameters. Sometimes, rainbow colors are visible in the intricate patterns.

Various other stunts can be performed with some of the common salts. By allowing a copper sulphate solution to crystallize at fairly high temperatures, around ninety degrees, interesting spiral patterns can be produced. By adding a little colloidal silica to solutions of metallic salts, many fascinating spiral and curved patterns are formed by the crystals. The solution should contain about three or four percent of colloidal silica, according to some microscopists. Commercial water glass (sodium silicate), sold for use as an egg preservative, contains a considerable amount of colloidal silica.



In circle, mosaic of copper and magnesium sulphate crystals. Above, crystals of oxalic acid



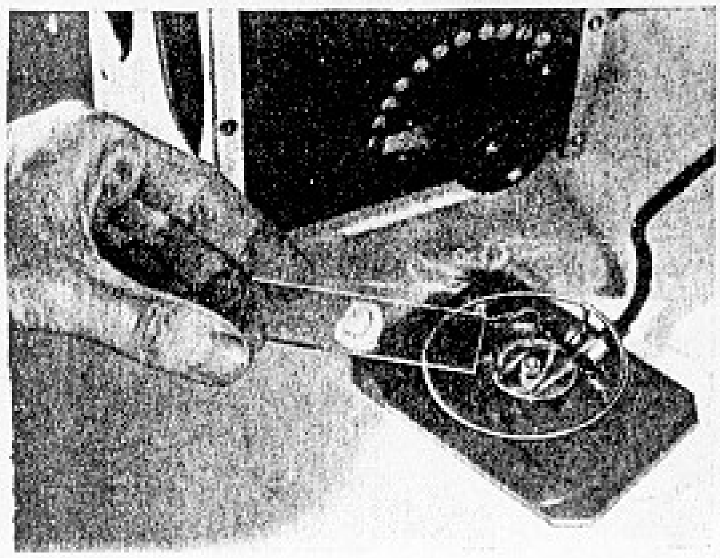
The diamond-shaped object at the right is a rhombic sulphur crystal, magnified forty-five times

Water is not always the solvent employed for making solutions from which crystals grow upon evaporation. Sulphur, for instance, is insoluble in water but dissolves readily in carbon disulphide. There are two crystalline forms of sulphur, the monoclinic and rhombic. Melt a quantity of sulphur in a small crucible—a small tin can will do—being careful not to let it catch fire. If it does, smother the flames by placing a piece of cardboard over the container. Fumes of burning sulphur are irritating and, in sufficient quantities, poisonous. When the sulphur has become liquid, set the container aside to cool. After part of the sulphur has solidified, pour out the liquid center. This will reveal a mass of long, slender, pale-yellow crystals of monoclinic sulphur. In time, at ordinary temperatures, these will turn to masses of rhombic sulphur.

THERE is a quicker method of producing rhombic sulphur crystals. Dissolve some sulphur in carbon disulphide, pour a few drops of the solution on a glass slide, and let the solvent evaporate. Scattered rhombic crystals of varying sizes will result. At fifteen or so diameters, these are very beautiful. In handling carbon disulphide, keep it away from fire, as it is highly inflammable and explosive.

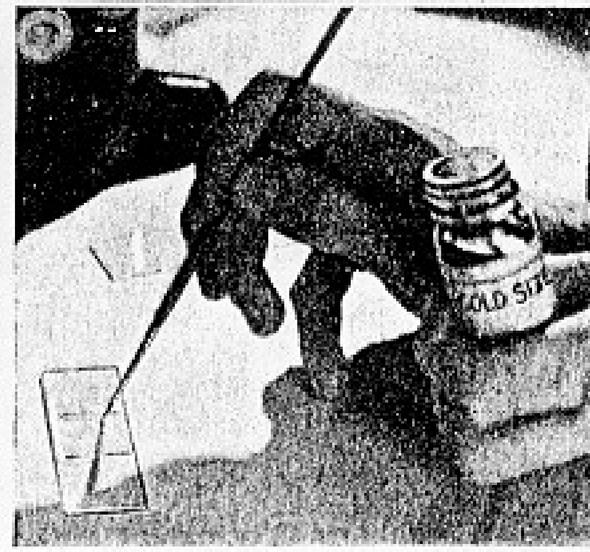
In your study of crystals, you will find that, while each substance that crystallizes does so in accordance with a definite plan or pattern—a fact that is of value in recognizing unknown materials—the final crystalline pattern may not always be the same for each material. You can demonstrate this with a solution of common salt.

Place a drop on a slide and heat it gently. Soon the water at the edge of the drop will evaporate, and the solid material will be visible as a ringlike deposit. Sometimes, masses of crystals will grow out from this ring with amazing rapidity, soon covering the entire area of the drop. If you remove the



3 Drive off water by heating the slide gently. The heater shown in the illustration is the resistance unit described. The transformer is in the background

4 To protect a crystallized chemical from moisture, place a drop of castor oil over it and set a clean cover glass on top of it



5 For permanent preservation, seal the castor-oil mount by applying gold size in a ring around the edge of the cover glass

source of heat as soon as the edge deposit appears, crystallization will proceed at a slower rate. Under the microscope, you will see that the edges of the area of solid material, formed while the slide was being heated, have a structure that differs from that of the central portion. Yet all the solidified material has crystallized according to an unvarying plan provided, of course, there is but one crystalline substance present.

Crystals exist abundantly in nature. Perhaps no more beautiful forms are to be found than the masses of crystals that fall to the earth as snowflakes. Snow crystals belong to the hexagonal or six-sided system. Perfect snowflakes always have six sides or rays or points. So endless are the possible ways in which the crystalline form can be varied, that no one ever has found two identical snowflakes. Some flakes consist entirely of thin plates, others of heaped-up prisms, and still others of combinations of these forms. The angles bounding these snowflake figures are always sixty or 120 degrees.

THE microscopic study of snowflakes requires certain conditions. The temperature must be low, from twenty-five degrees to zero F. being favorable. The microscope and all equipment must be at the same temperature. Generally, it is possible to work in a garage or on a sheltered porch, where temperature conditions are right. You can collect the flakes on a piece of black hard rubber, a painted board, or a piece of black cloth that has been outdoors long enough to acquire the temperature of the surrounding air.

Hold the collecting board where the flakes will fall on it. You can select the most promising flakes and transfer them to cold glass slides with the aid of feathers; or you can collect them on the slides in the first place, by laying clean slides on the board. Instead of standard slides, you could use thin one- by three-inch pieces of hard rubber or wood painted black. Most of your observing will be by reflected light, so that you do not really need a transparent support.

A snowflake will not last very long because, even at a low temperature, the ice crystals evaporate. The only way to preserve the beauty of its form is to make a photomicrograph of it. In doing this, you cannot use artificial light sources because they produce too much heat. Try making pictures both by transmitted and by reflected daylight.

It is not a difficult matter to preserve indefinitely many of the crystalline wonders you create by evaporating solutions. Some materials, such as rhombic sulphur, will exist indefinitely in air, so that they can be mounted on a glass slide without an embedding medium. A convenient way of doing this is to cut a ring, from cardboard or other material, whose outside diameter is slightly greater than that of the cover glass you are going to use, and whose inside diameter is somewhat less. Soak this ring, if it is not of moisture-proof material, in thin shellac and let it dry. Cement it in the center of a clean one- by three-inch glass slide, with Canada balsam.

Over the bottom of the cell thus formed, spread a very thin layer of balsam and let the solvent evaporate. When the balsam film has hardened, arrange the crystals over it. Then gently warm the slide until the balsam becomes sticky enough to cause the crystals to adhere. If you cannot do this without damaging the specimens, put the crystals in place before the balsam has dried completely, or flow a little xylol over the hardened film. Finally, cement a clean cover glass over the cell, using balsam around its edges.

Many crystals, such as those of the double sulphate of copper and magnesium, must be preserved so that no water can get to them. When the crystallization has progressed as far as you want it to go, heat the slide gently to stop further crystal formation. Then apply a little pure balsam, and drop the cover glass into place. It is important that all of the crystalline area be covered with the balsam, so that no moisture can creep in.

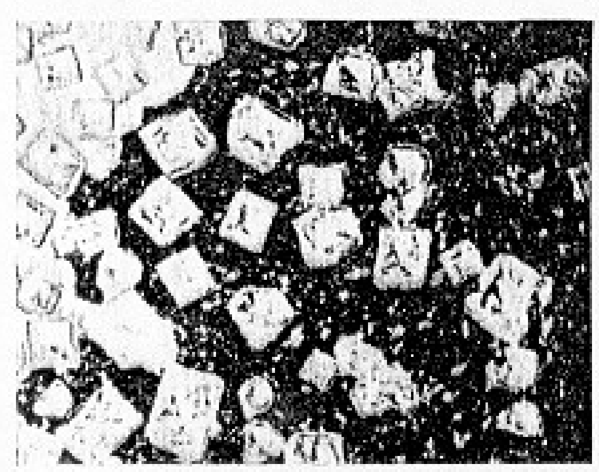
Crystals can be mounted in castor oil. It is better to use the refined variety to avoid an odor, which is unpleasant to some people. Place a drop of oil over the crystals, then a cover glass, and your specimen will keep indefinitely, provided the oil or cover glass is not removed. Permanent slides, which will last for years with reasonable care, can be made by removing all excess oil with a piece of filter paper moistened with xylol, and ringing the cover glass with gold size. Place the slide in a horizontal position until the gold size hardens. Give it another application if necessary, and finish by ringing with asphalt varnish.

IN PREPARING specimens of crystals, and in doing a great many other things in microscopy, a source of heat is desirable. While the Bunsen burner and alcohol lamp have become standard pieces of equipment in laboratories the world over, there are times when a source of heat not involving a flame is desirable. A small electric heater fills the bill nicely.

One form of heater can be improvised from an empty tomato can, a lamp socket, asbestos-covered wire of the kind used for electric irons and toasters, connection plug, incandescent lamp, and some clean silica sand or "bird gravel." Mount the socket inside the can, on the bottom. Connect the wires to the terminals, and lead them out through a hole punched in the side of the can. Seal the wires in this hole by forcing about them some shredded asbestos or other material that will resist heat.

Screw the lamp into the socket, and pour sand around it until only the top is visible. The sand is to prevent heat from escaping in appreciable quantities except at the top. Cover the top of the can with a piece of copper screen wire, to act as a support for slides or containers. If you want to subdue the light from the lamp, add a disk of red, fireproof transparent material of the type used over show-window lamps, spotlights, and the like. An added refinement is a covering of asbestos around the outside of the can, to act as an insulating layer when the heater is operated for considerable periods.

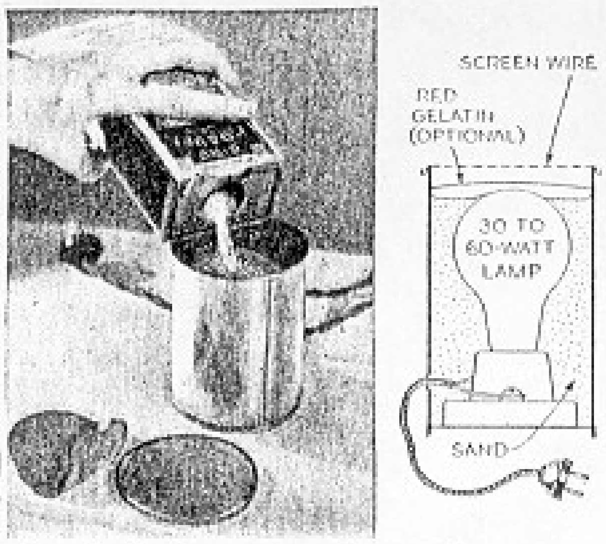
In using this heater, be careful not to run it so long at one time that the lamp will be damaged. A lamp of the old carbon type, which gives more heat than light, can be used. Some of the special therapeutic or electric-heater lamps can be employed. Special lamps made for use inside ovens ought to prove satisfactory, if the imprisoned heat seems to damage ordinary lamps. When ordinary



This fantastic wonderland is composed of potassium bromide crystals, magnified 300 times

inside-frosted bulbs are used, thirty-, forty-, or sixty-watt sizes are about right, depending on the intensity of heat that is best suited for the work being carried on.

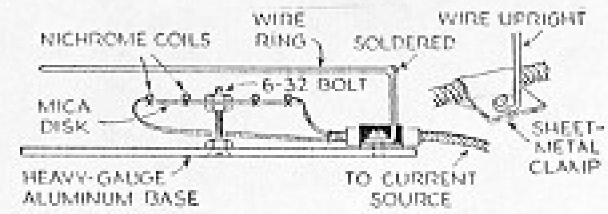
If you have a transformer for operating a



An electric lamp mounted in a tin can and surrounded by sand makes a handy heater

108-watt microscope lamp, or a toy transformer of sufficient capacity (such as the 150-watt size), you can wind a resistance unit from nichrome resistance wire, experimenting to find the proper length. The wire can be wound in a pancake spiral or zigzagged like the letter M, and mounted on an insulating, heat-proof support such as a piece of asbestos, slate, or mica. A mica disk taken from a burned-out fuse plug is excellent. Use fairly fine resistance wire, something like No. 28. A foot or so ought to be about the right length, for operation on four to six volts; but the best length can be found by test. Make a springlike coil by winding the wire around a darning needle, and then fasten the coil to the support. One way of doing this is to punch or drill holes in the support at intervals along the coil, bend short lengths of the resistance wire into the shape of a hairpin, and use these as staples to pass through the holes of the mounting support.

MOUNT the heater unit on an upright brass bolt passing through the center of a rectangular piece of sheet aluminum or other metal big enough to form a rigid base. The coil should be about one half inch above the plate. Bend a piece of stiff brass wire into a ring, with one end projecting to form a leg, and mount it as shown in the illustration to make a support for the specimen slide which is to be heated.



Details of construction of electric resistance heater easily wound from nichrome wire

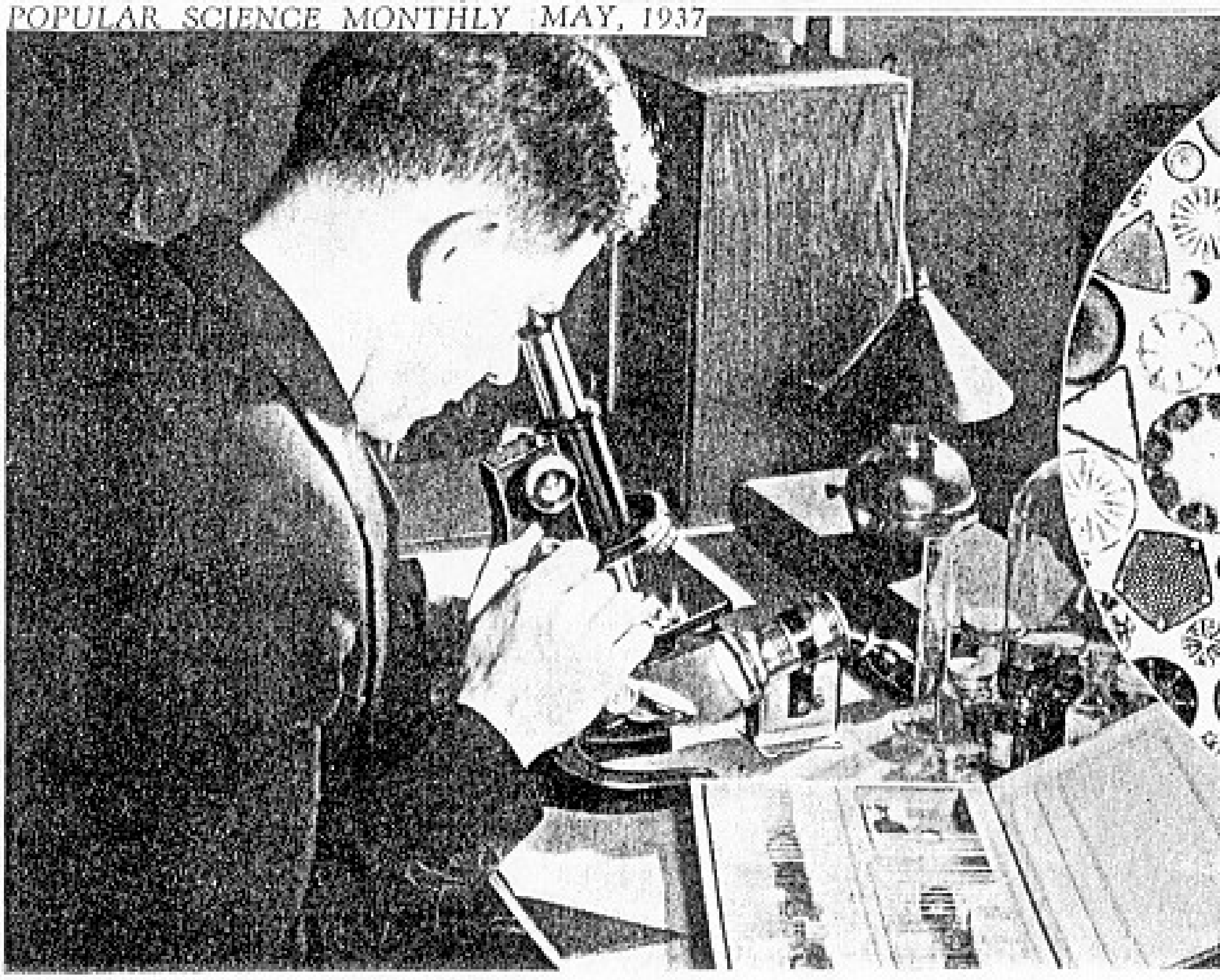
Connect the ends of the resistance wire to insulated wires running to the transformer secondary, and your heater is complete. You will find that a little heater of this type is surprisingly efficient, and one of the handiest pieces of equipment you can add to your microscope laboratory. Because of the low voltage used, there is no danger of shock; and it is safer to use, from a fire-hazard standpoint, than the conventional heater which employs an open flame.

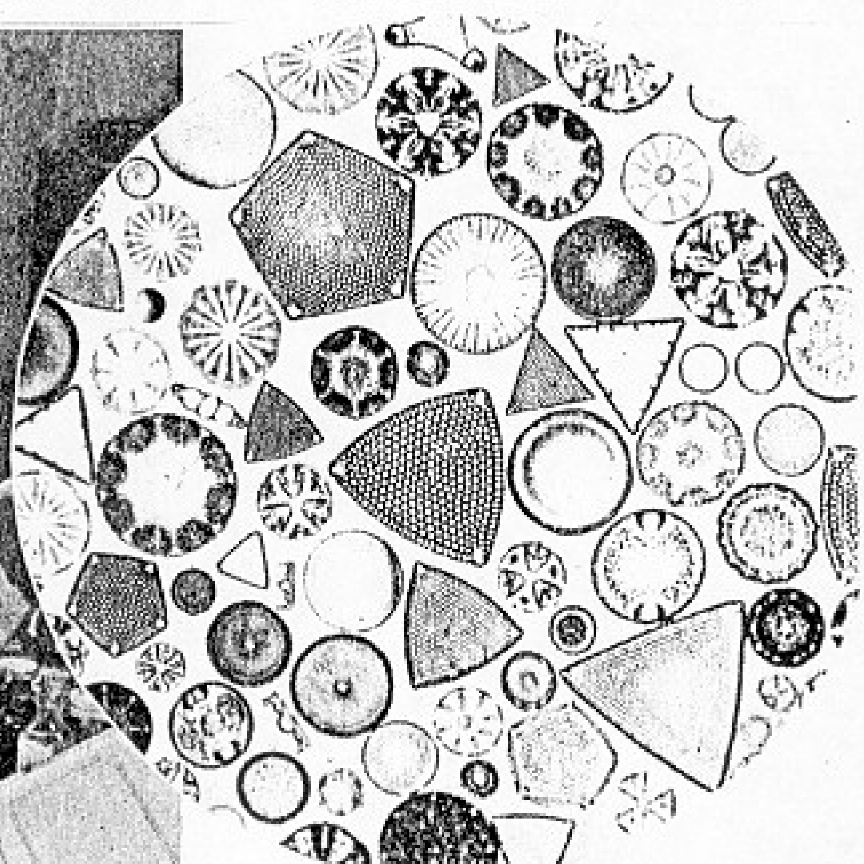
Nature's Jewel Boxes . . . *Wonders of Plant Skeletons* REVEALED BY YOUR MICROSCOPE

Scooped from The Mud of Any Garden Pool, Tiny, One-Celled Diatoms Prove Fascinating Specimens for Study Under The Magic Lens

By Morton C. Walling

POPULAR SCIENCE MONTHLY MAY, 1937





Here are just a few of the many varieties of diatoms. Bringing out the fine details is a good test of your microscope's resolving power

DID you ever see an exquisitely carved jewel box, made of precious metal or crystal, and ornamented with delicate handwork? A box that has a bottom part and a lid that fit snugly together with sides overlapping?

You can find such examples of the jewelry-maker's art in many museums, some of the specimens dating back for hundreds of years. But in almost any wayside ditch, you can find countless miniature jewel boxes that may be many *thousands* of years old, and whose beauty and delicate detail far outshine anything ever made by man.

Found in garden pools, streams, lakes, and seaside puddles, these microscopic works of art are known as diatoms, or, to give them their scientific name, Bacillariaceæ or Diatomaceæ. They are among the most fascinating wonders upon which the microscopist can turn his magic lenses.

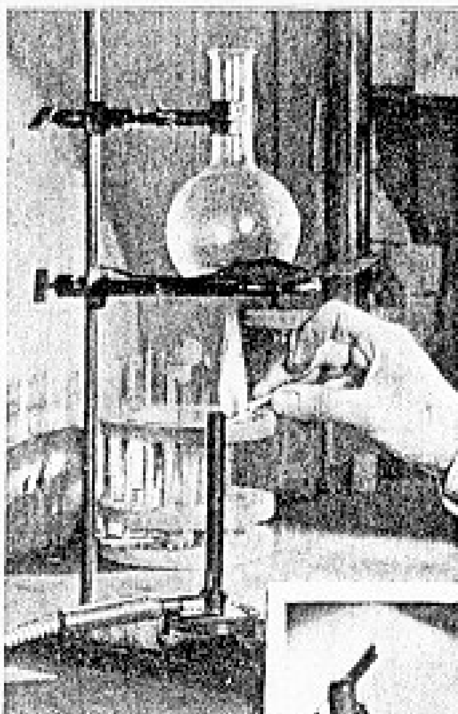
Diatoms are classed by biologists as algæ. They are one-celled plants, generally yellow in color in their living form. Sometimes they may be strung together to form chains, like fairy necklaces, or they may collect in masses. The membrane of the single cell is made hard and glassy by silica, which is glasslike in appearance and of the same chemical composition as silica sand. But the difference between a diatom and a grain of sand is greater than that between a milk bottle and a cut-glass punch bowl turned out by a master craftsman.

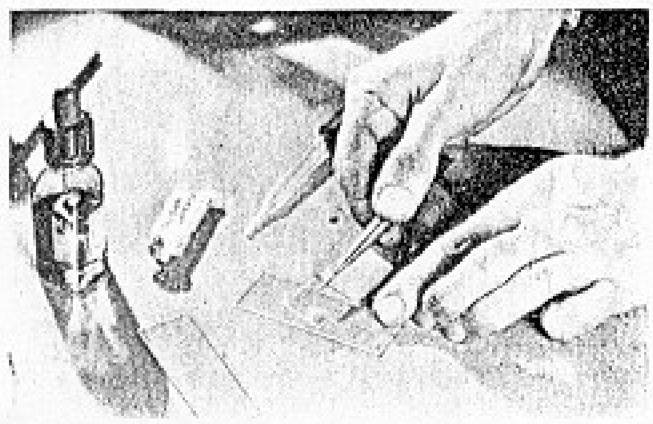
The silica membrane or "skeleton" of the diatom consists of two plates called

valves. In most diatoms, these parts fit together like the halves of a flat pill box, their edges overlapping. This overlapping region is called the "girdle" side.

It is because of the markings on its silica skeleton that the diatom is famous as a microscopic object. The surfaces of the valves are covered with lines, grooves, dots, and striations arranged in systematic order to form a decorative scheme rivaling the carving on a piece of jewelry.

Many diatoms are able to move about in the water in which they live. You can see them swimming across the field of your microscope like little yellow animals; yet they are classed as plants. These lit-





PREPARING DIATOM SPECIMENS FOR PERMANENT MOUNTING

Organic matter is first removed by careful boiling in acid, as above. The specimens are then washed with water. Upper right, dropping a little water containing diatoms on a cover glass. When the water evaporates, thin balsam is added, and the glass is cemented to a slide, as at right

tle one-celled creatures have two ways of reproducing themselves. In the "sexual" method, a single cell throws off its membrane, and unites with another diatom to form a sexual auxospore, or reproductive cell, from which new individuals develop.

In the "asexual" method, a cell discards its membrane and then changes into one and sometimes two auxospores.

Diatoms are among the most plentiful microscopic bits of life to be found. Their distribution is world-wide. You will find them in both fresh and salt water, in every pond, sluggish stream, seaside puddle, and back-yard lily pool—in fact, wherever water stands in a relatively stagnant condition for a length of time. They also occur in swiftly flowing streams, but there they may not be easy to collect.

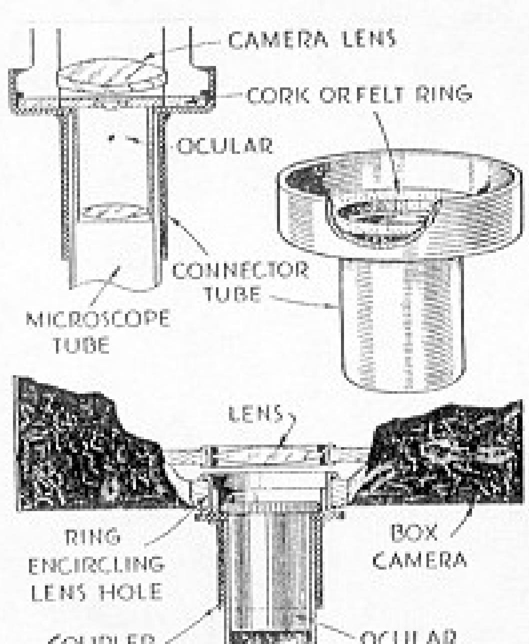
You can find diatoms in winter or summer, whenever it is possible to collect some of the mud on a pond bottom. With a large spoon, a long dipping tube, a net made by sewing a muslin bag to a loop of wire attached to a long handle, or even a wide-mouthed glass bottle, you can skim a thin layer of mud from the bottom of a pond. Select, if possible, places where yellowish-green patches are visible on top of the mud. Filaments and raglike formations attached to the roots of water plants, submerged stones, and sticks, usually are rich in diatoms. Moss of various kinds may provide abundant material. Diatoms of the sea can be found adhering to shells, coral, and other underwater objects.

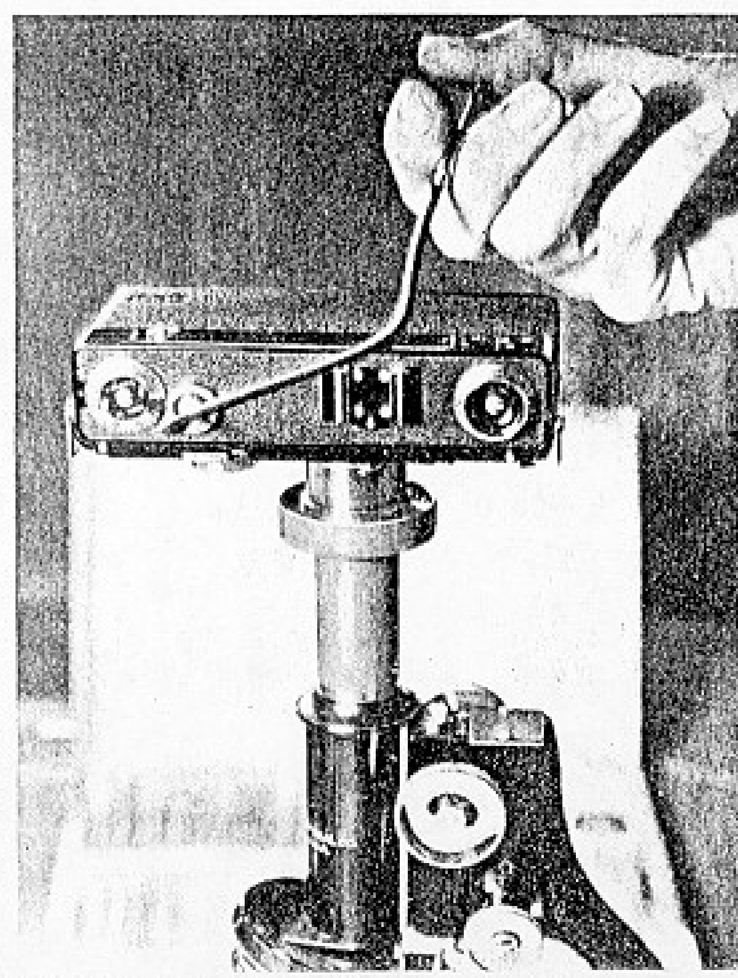
After you have gathered a supply of material that you suspect may contain diatoms, return to your laboratory and prepare for one of the most interesting investigations you ever attempted with your microscope. With a dip tube, lift a bit of the settled matter from the bottom of one of your collecting bottles and deposit it on a slide. Add a cover glass, being sure there is sufficient water to provide complete immersion but not much more.

You can identify the diatoms by their brilliant yellowish color, and their symmetrical glass skeletons. Some of the skeletons will be empty. These are the silica remains of diatoms that may have lived centuries ago, for these tiny, marvelously formed bits of glass are virtually everlasting.

Diatoms range in size from tiny specks up to about the dimensions of a period on this page; a microscope is the only key to their wonders. Do not expect to see all the details with your instrument, for even the finest and most powerful lenses made have difficulty in resolving some of the details of diatoms. For instance, photomicrographs showing cilia are comparatively rare. Cilia are the minute, hairlike appendages that project through the glass skeleton and, by waving back and forth in the water, enable the diatom to swim. Dots and other markings on the silica valves are so fine that they are employed to test the power of oil-immersion objectives and other microscope lenses.

But even though your microscope may lack the magnification and the resolving power required to reveal the more detailed wonders of these tiny objects, it still can make visible a wealth of detail if it magnifies 100 or more diameters. There are so many varieties of diatoms that you





HOW TO PHOTOGRAPH DIATOMS WITH AN ORDINARY CAMERA

By constructing one of the couplers shown above, you can mount any folding or box-type camera on the eye-piece of your microscope for making a permanent photographic record of an interesting specimen. The camera lens should be focused at infinity

might spend your entire life studying them, and still fail to see all existing forms.

The silica valves usually are the parts preserved in permanent preparations, for they are the most interesting. Before you can mount them, it is necessary to remove the organic matter. Sometimes, simply boiling the diatoms in nitric acid, and then washing them well with water, will be sufficient. However, expert diatom handlers usually employ a more involved process. In handling any of the acids mentioned here, do so with extreme care and in a well-ventilated place. Do not breathe the fumes, and keep the chemicals away from your clothing and skin.

To separate diatoms from organic material, bits of shells, or other matter, place a quantity of the collected material in a flask or test tube and drain off as much of the water as possible. Add a little hydrochloric acid and boil until the plant material has become almost black. It is a good idea to let the specimens remain in this acid for about a day after it cools. Then add water, let the material settle, and carefully pour off the water. Repeat this several times. Let the flask stand several hours after the final washing, and then pour off all the water possible.

Any remaining traces of organic material may be removed by adding several drops of sulphuric acid, one drop at a time, to the mass in the bottom of the tube, and heating slightly. Organic substances will turn black. Next, add a little piece of potassium bichromate, to remove the blackened portion. Let the contents of the tube cool, and then pour them into a tube or beaker of water. *Never pour water into the tube, for an explosion might result.* Finally, rinse several times with water as described above, and, except for the presence of sand, your diatoms are ready to mount.

TO SEPARATE the sand from the diatoms, place the mixture in a test tube half filled with water, and shake. Let it stand until the sand has settled, leaving the diatoms, which are lighter, suspended in the water. Pour off the water and diatoms.

Keep the cleaned diatoms in labeled vials of distilled water to which a little alcohol has been added. When ready to make a permanent mount in balsam, clean a cover glass and slide until no grease film is present. Lay the cover glass on a one by three-inch slide, and this in turn on a perfectly horizontal surface. Now place in the center of the cover glass a drop of water containing diatoms. Put some kind of a dust shield over it, and let the water evaporate. Carefully lift the slide bearing the cover glass, and place it on your microscope stage.

If, on examination, you find that the diatoms are sufficient in number and well-distributed, carefully place in the center of the cover glass a drop of fairly thin Canada balsam. Warm it, if necessary, to make it spread to the edges of the cover glass. When the balsam has hardened, lift the cover glass from its temporary support, turn the balsam side down, and lower it to the surface of a clean slide, that has been previously warmed and had a drop of fresh balsam placed in its center. The cover glass should be pressed lightly into place, with the balsam spreading uniformly to the edges. Do not use more balsam than necessary. Patient workers sometimes produce slides of great beauty by arranging diatoms of various forms in geometrical patterns and designs.

DIATOM skeletons millions of years old are available from various sources. Such fossilized remains make up the bulk of diatomaceous earth, or kieselguhr. They are used as ingredients in tooth pastes and powders, and in scouring preparations; and, of course, specimens suitable for microscopic study can be obtained from such sources.

A particularly effective way of examining diatoms with the microscope is to use Rheinberg differential color illumination as recently described. (P.S.M., April, '36, p. 44). A blue center disk with a yellow or very light red ring around it reveals unsuspected beauty.

You can record the wonders you see in diatoms, and in other microscopic objects as well, by coupling a camera to your instrument and making photomicrographs.

There seem to be about as many different kinds of photomicrographic outfits as there are diatoms. Some of the professional layouts cost more than a high-priced automobile. But with nothing more than a microscope, an ordinary camera, and a few pieces of colored glass or gelatin, you can turn out surprisingly good work.

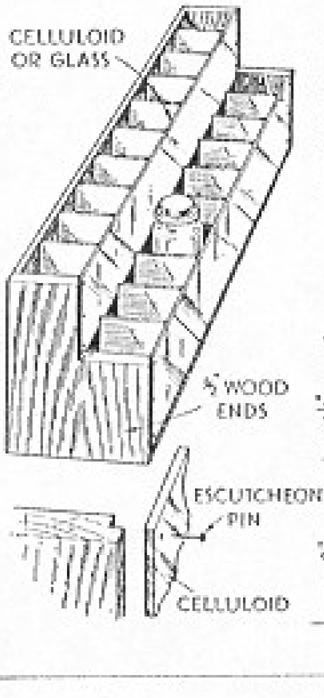
Although you can juggle a tripod with a tilting head so that the camera it supports has its lens aimed down the microscope tube, it is better to make a special support or coupling. One of the illustrations in this article shows a miniature camera attached to a microscope by a ring made of brass. A similar ring can be built up of sheet celluloid painted black.

The object of such a camera support is to hold the camera lens in approximately the same position as your eye when you are making visual observations. That is, the lens is placed at the eyepoint of the microscope ocular. You can use any kind of camera, from a cheap box type to the highest-priced imported variety.

SHARP focus is obtained by the following method: First, put the object, a diatom, for instance, under the microscope, and focus it carefully, just as if you were going to make a visual study of it. Next, focus the camera on some distant object—something 200 feet or more away. This is called the "infinity" setting on focusing-type cameras. If you use a fixed-focus camera, you need not do any lens adjusting. Now support the camera so that its lens occupies the same position that your eye occupied when you focused the microscope. Make the exposure by placing a sheet of cardboard between the microscope mirror and the light source, opening the shutter, removing the cardboard long enough to admit the light for the necessary length of time, and then closing the shutter. By using the cardboard instead of the camera shutter for making the actual exposure, you avoid excessive vibration.

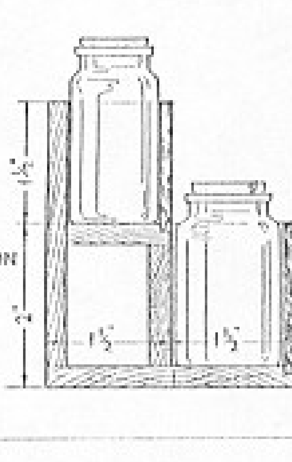
Microscopes perform better if monochromatic, or one-color, light is used for illuminating the object when making pictures. For this, gelatin or glass filters, which permit only light of certain wave lengths to pass, are placed in the light beam, between mirror and light source. For photographing diatoms, green or blue filters generally are used, with green perhaps the more popular.

Storage Racks for Reagent Bottles Are Easily Made

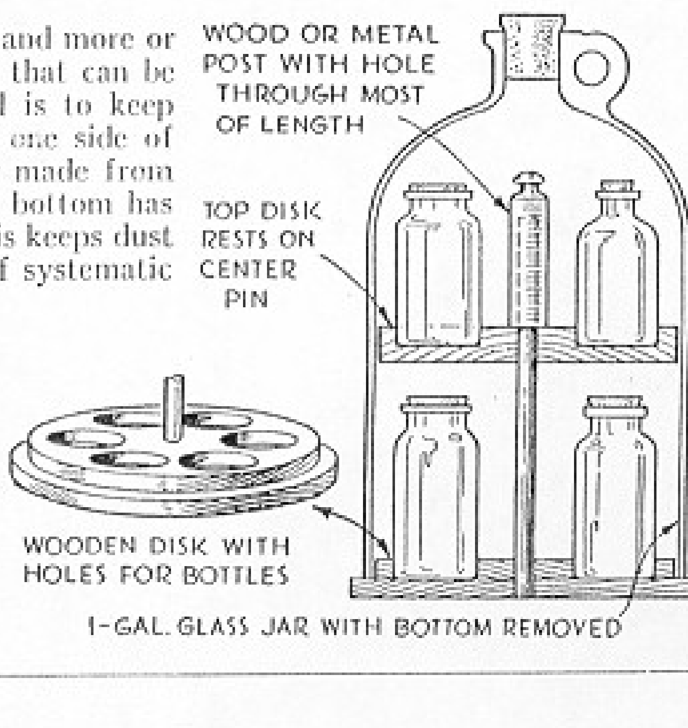


BOTTLE RACKS

The problem of storing reagent bottles is easily solved by building this handy double-level rack



KEEPING reagent bottles in order and more or less free from dust is a problem that can be solved in various ways. One method is to keep those that are used most grouped at one side of the microscope desk, under a bell jar made from a one-gallon glass jug from which the bottom has been cut, as indicated at the right. This keeps dust off, but lacks something in the way of systematic arrangement. A long rack, with a place for each bottle, is better, especially for those reagents that are less frequently used. A convenient unit of this type can be made as shown in the drawing at the left. The use of celluloid permits the labels to be read easily, and hinged covers may be provided, if desired, to keep off dust.

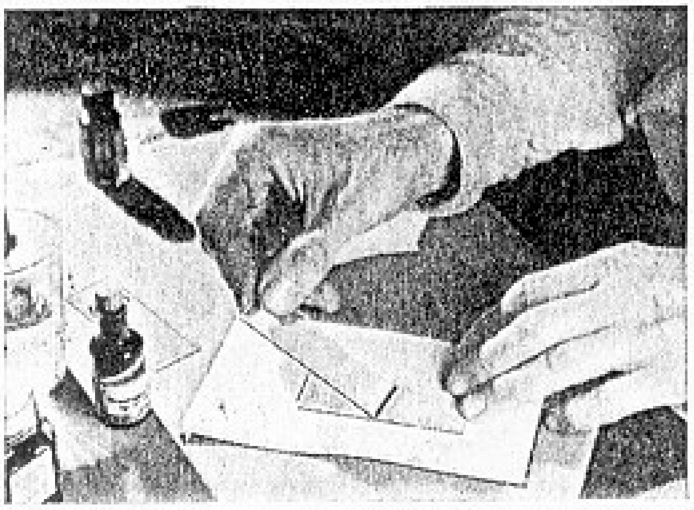


POPULAR SCIENCE MONTHLY MARCH, 1937

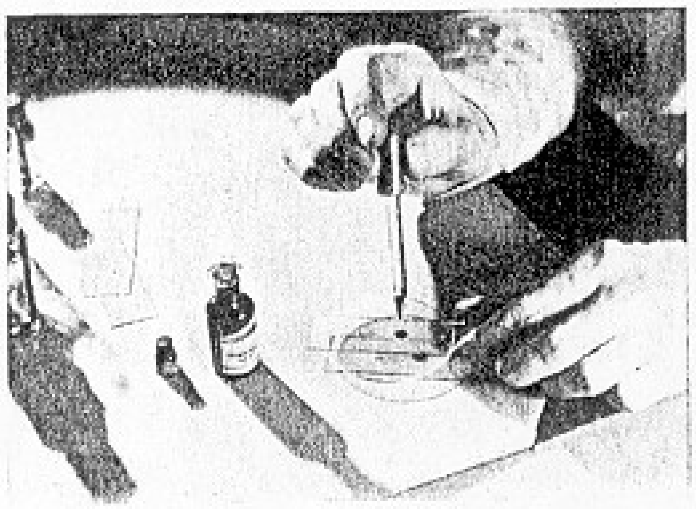
Help Your Microscope *with* Stains *and* Reagents

How To Use Simple Chemicals To Bring Out The Obscure Details of Your Specimens and Reveal New Wonders to Your Magic Lenses

By Morton C. Walling



1 The first step in staining a specimen of blood. Spread the blood into a thin film or smear, either on a slide, as shown, or between two cover glasses



2 Dry, fix with alcohol, and apply the stain. Use a medicine dropper, or, for stains that act slowly, immerse completely, as shown on the opposite page

3 The stain, in this case a commercial product, is rinsed away with water. Distilled water is, of course, best. Dry the slide, keeping it free of dust

CAN you give information about any of the following stains and reagents, as to use, and the preparation and treatment of the specimen?"

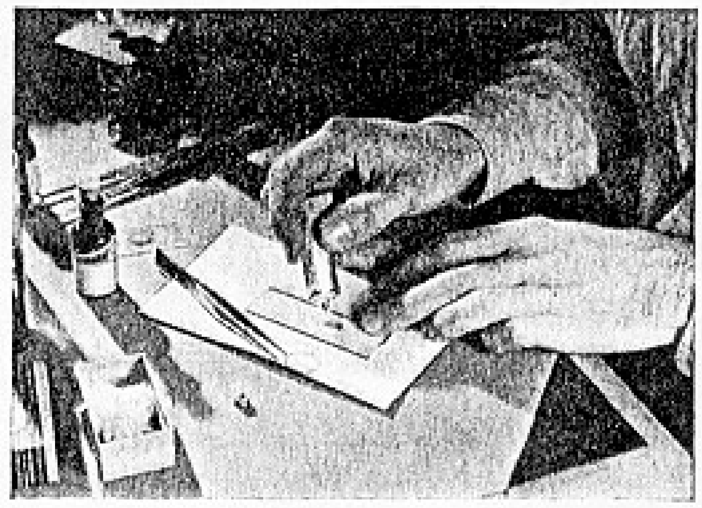
That is what one microscope fan asks. And he lists exactly thirty-nine items, some of which are commonly used in microscopy, and some of which are seldom mentioned outside of a well-supplied laboratory. But his question is typical of a great many asked by amateur microscopists—questions justified by the importance of stains and other chemicals in the proper pursuit of this fascinating hobby.

The use of aniline dyes and other staining materials in microscopy is, very frequently, much like the administering of a magic potion. The resulting changes are so wonderful and beautiful that, to the observer who has never before seen anything of the kind, they are little short of miraculous.

Stains are applied to specimen material for several reasons. They color otherwise indistinct objects and make them easy to see. Bacteria provide an example. They color parts of objects, making them stand out from other parts. Sometimes two or more colors are used for this. Thus, in work with animal tissues, it is a common practice to stain cell walls one color and nuclei another. Stains add to the beauty of an object, such as the cross section of a plant stem. This may not be of primary importance to the scientist, who is trying to differentiate between parts of the structure rather than make them more beautiful; but to the amateur, who is pursuing his hobby largely because it is fun, this reason for staining may be more important than the others.

Specimens may be stained either in bulk or in sections. That is, chunks or pieces of the material, or the whole insect or small animal, may be immersed in the stain; or it may be sliced into thin sections and each section stained after it has been transferred to a slide. The second method is perhaps the better, where material is sectioned. Of course, bacteria, very small insects and the like are stained in bulk, but they are handled very much as if they were sections.

Generally speaking, microscope stains can be classified into three distinct groups of materials. The first group, consisting of common household substances like iodine, are particularly popular with the amateur because they are inexpensive and readily available. Eosin, a red dye, and methylene blue are good examples of the second group of stains, which consists mainly of substances that belong definitely to the art of microscopy. The third class is a group of commercially prepared stains sold under brand names like patent medicines. These commercial stains, as well as those in the second group, can be obtained from any dealer in microscope supplies.

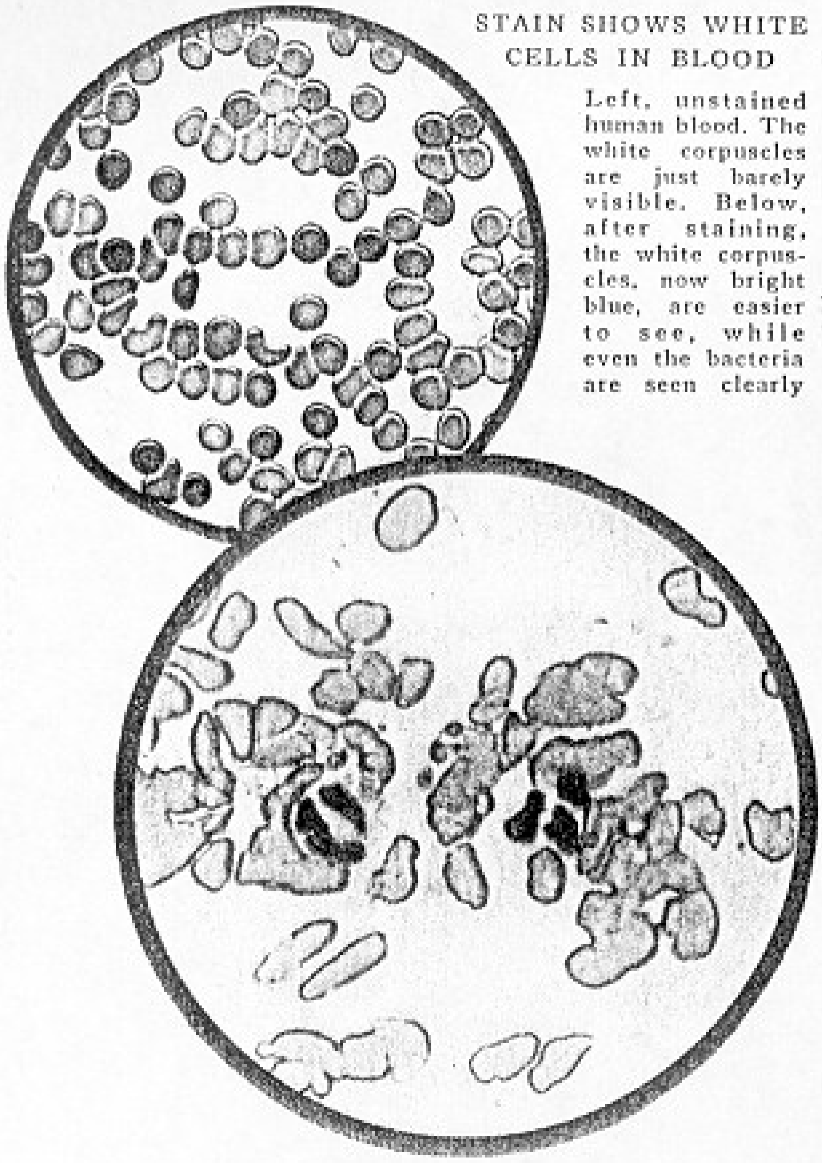


4 After drying, the specimen is ready for examination. Although the blood smear is surprisingly durable, attach a cover glass permanently with balsam

Iodine has been mentioned as a readily available stain; mercurochrome is another. As a matter of fact, almost any soluble coloring ingredient can be used with some degree of success. Household dyes and water-color paints sometimes work very well. One of the simplest and most dependable stains for use with the well-known slipper-shaped paramecium is ordinary writing ink, and the technique is very easy to master.

Put a drop of water that contains paramecia on a slide, add a cover glass, and focus the specimen. Now remove the cover and apply a little red ink with a toothpick or the head of a pin. When the cover glass is replaced, examination will show that the staining has made the trichocysts, or stinging organs, and the hairlike cilia stand out clearly. After about four minutes, take a fountain pen containing blue ink, and touch its point to the edge of the cover glass. Watch the reaction through the microscope. As the blue ink is drawn in under the cover glass, observe the paramecia plunging into the advancing wave of blue. The cytoplasm, or main part of the single-celled creature, turns a beautiful, deep red with a purplish tinge; the eyelashlike cilia become flame-colored, and the defensive trichocysts are a deep blue.

Among the special microscope stains which fall into the second classification, there are so many useful chemicals that



STAIN SHOWS WHITE CELLS IN BLOOD

Left, unstained human blood. The white corpuscles are just barely visible. Below, after staining, the white corpuscles, now bright blue, are easier to see, while even the bacteria are seen clearly

Staining a slide by complete immersion. Because many stains call for prolonged soaking, it is worth while to secure a special glass vessel like the one shown

it is difficult for the beginner to decide which to buy first. The one that should be at the head of every microscopist's shopping list, however, is eosin. For general work, both water and alcohol solutions should be kept on hand. Another useful stain, which is particularly suited for work with bacteria and plant material, is methylene blue. Safranine also works well with plant tissues, while methyl green and neutral red can be used for any living specimens.

Although haematoxylin often is used in conjunction with eosin for double-staining animal tissues, and with safranin for plant material, it also can be used independently for plant life, producing a rich, purple color that is well worth observing.

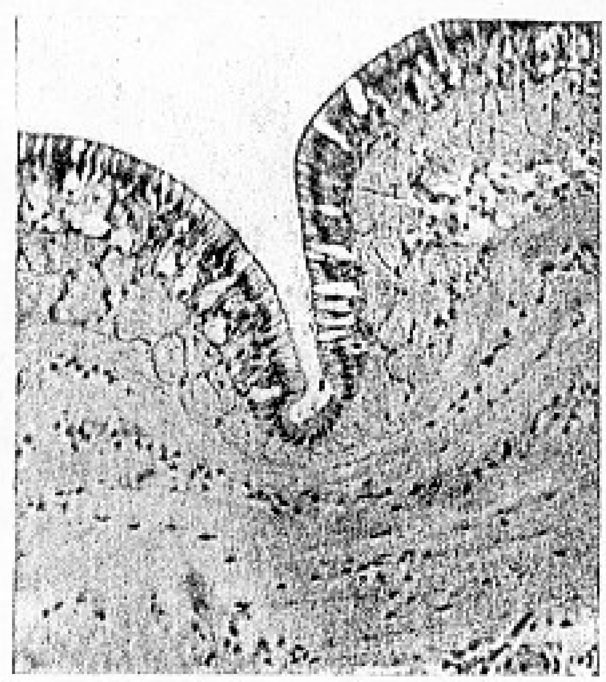
Select a leaf stem from a plant such as a geranium, and cut several thin specimens with a wet razor blade. Mix half haematoxylin and half water, and soak one of the specimens in it for ten or fifteen minutes. Remove the plant material, wash it in water, and soak in alcohol for a few minutes. Then immerse it in aniline oil until clear, and wash for a minute or two in xylol to remove the oil. Keep the specimen wet with xylol while you are examining it under a cover glass. If it is a good section, make it a permanent mount in balsam.

Blood is not easy to stain, but it can be accomplished with a fair degree of success with nothing more than eosin.

Put a thin smear of blood on a cover glass, and allow it to dry overnight. The next day, place the cover glass, blood side up, on a metal plate, and heat it gently for about a half hour. When the glass has cooled, apply a drop of eosin, spreading it evenly over the surface, and allow this to remain for half an hour. Next, wash away the excess stain in water, and dry the specimen by touching a piece of blotting paper to its edge. Whatever moisture remains can be removed by holding the cover glass over a small flame for a few seconds. Put the glass, blood side down, on a slide, and examine. You will be able to see the red corpuscles, or oxygen carriers of the blood, stained pink. The white corpuscles, not affected by the stain, will not be readily visible. A special technique is needed to color them.

For complete staining of blood, and for other specimens which present special problems, the amateur is advised to use one of the special commercial stains that are available. The method of using a typical prepared stain is shown in the photographs that accompany this article. Some of these special formulas are available to anyone who consults the textbooks on the subject, but it is usually not worth while to attempt making them up at home when they can be purchased already mixed at reasonable prices.

Certain stains require a rather com-



Cross section of a flower anther stained to make the cell nuclei prominent. Note the pollen grains

plicated procedure; others are simple to apply. Some are ready for use as soon as they are mixed, others have to "ripen" for a few days, or even months. Some do their work in a matter of seconds, others must soak into the specimen for several hours, or longer. The staining operation is often made more successful by the use of various other substances; fixers, dehydrating materials, hardening agents, solvents, and mounting media all

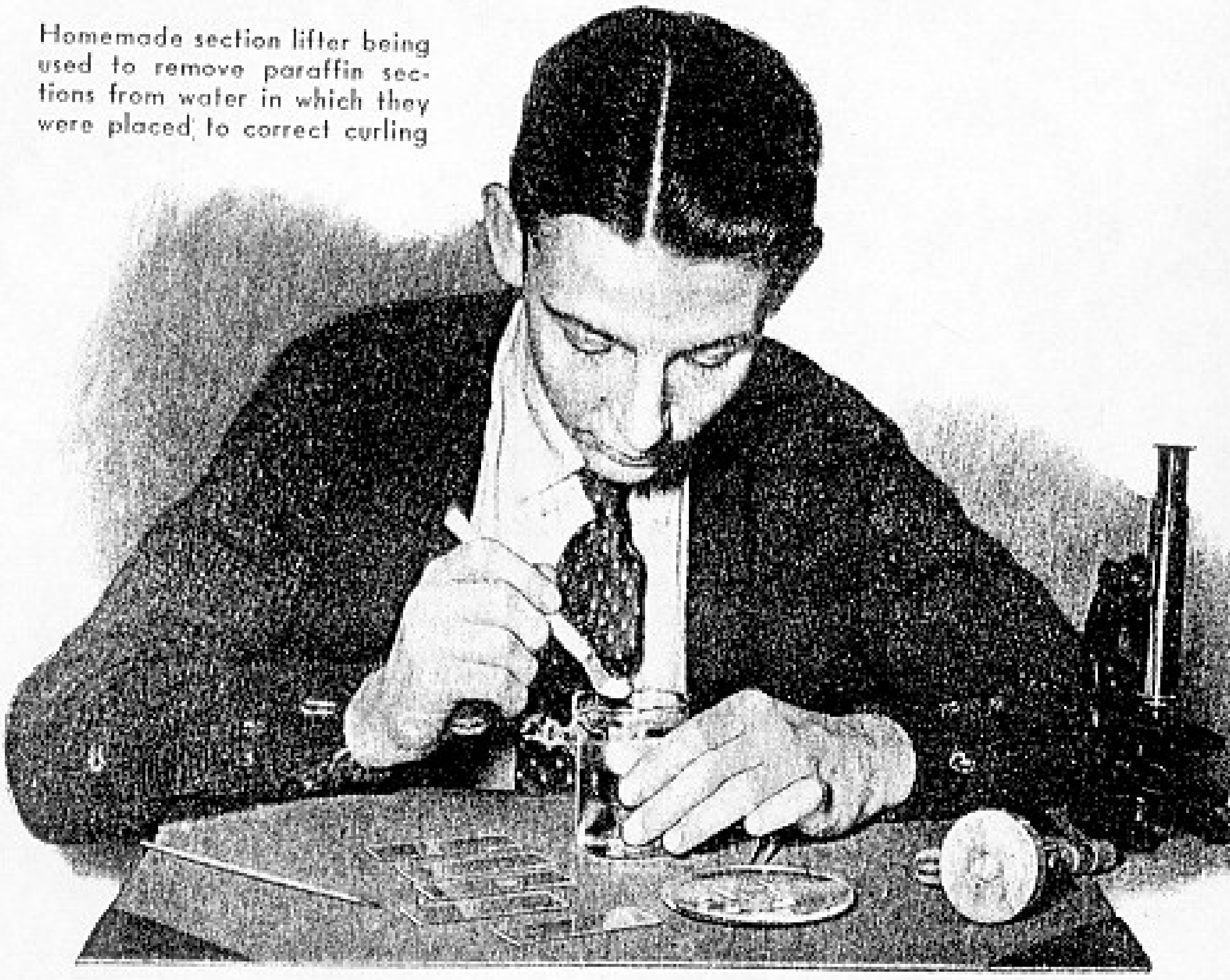
are closely related to stains. To help the microscopist to make an intelligent choice among the numerous stains and reagents he needs, a special bulletin has been prepared, listing the common stains and other chemicals used in microscopy, along with the properties of each, and directions for using them.

POPULAR SCIENCE MONTHLY
JUNE, 1938

Tissue-Thin Specimens MADE FOR YOUR MICROSCOPE

By MORTON C. WALLING

This Article Describes an Easy Method by Which Soft Substances Can Be Sliced into Sections by Setting Them in Paraffin



Homemade section lifter being used to remove paraffin sections from water in which they were placed to correct curling

IN SCORES of laboratories throughout the world, technicians are at this moment slicing animal and vegetable tissue into pieces thinner than the sheerest tissue paper. Botanists are carefully cutting up plant roots, stems, and leaves in order that they may study their inner wonders. Zoölogists are doing the same with bits of skin and liver and muscle from different animals, to get first-hand information about their structure and function. Plant pathologists section diseased leaves in order to identify the organisms causing the trouble. In hospital laboratories, staff pathologists speedily cut into minute slices bits of tissue sent up from the operating room, to learn exactly what is the matter with the patient.

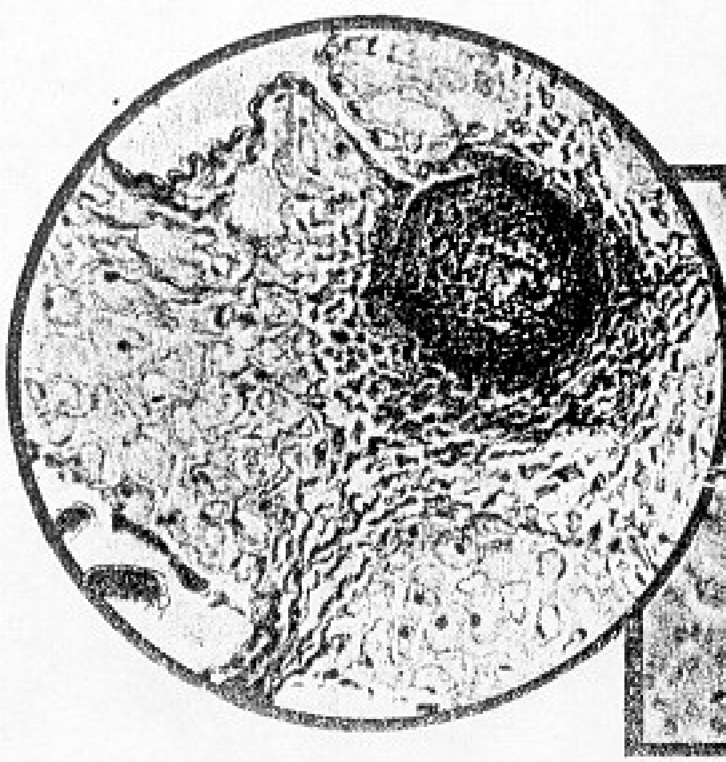
This slicing of plant and animal tissue—"cutting sections," it is commonly called—is one of the most important and fascinating branches of the extensive field of microscopy. Many laboratories employ skilled men and women who do little else. If you have constructed the microtome described in the preceding article (P.S.M., May 1938, p. 88), or have access to a similar instrument, you can duplicate these processes—a bit clumsily perhaps, at first, but with considerable pleasure nevertheless.

Without much research, you can prove to yourself that it is impossible to cut even moderately thin sections of soft substances such as beefsteak or chicken liver merely by grasping a knife and the tissue and going to work. Special preparation is necessary in order to produce sections thin enough to meet the demands of the microscope—something like ten microns in thickness. A micron is a thousandth of a millimeter, or 1/25,000 of an inch.

There are in use three fairly common processes of preparing tissue so it can be sliced with a microtome. One is to freeze it with expanding carbon dioxide or ether, or with dry ice. Another is to saturate the tissue with paraffin so that it is firm and rigid. And a third way is to saturate it with collodion.

Of these three, the most generally useful is the paraffin method, and this is the one to be explained in this article. The method consists, briefly, of fixing the tissue, extracting all the water from it, saturating it with paraffin, slicing, removing the paraffin from the slices, staining if necessary, and mounting in balsam or a similar medium.

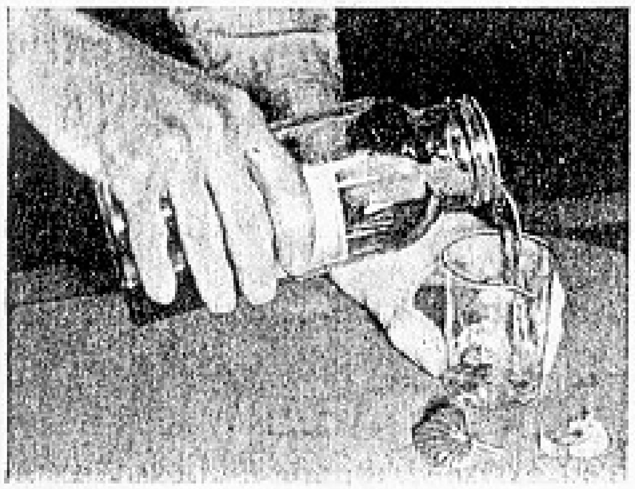
Before you go very far in a study of existing ramifications of the paraffin technique, you will discover that there



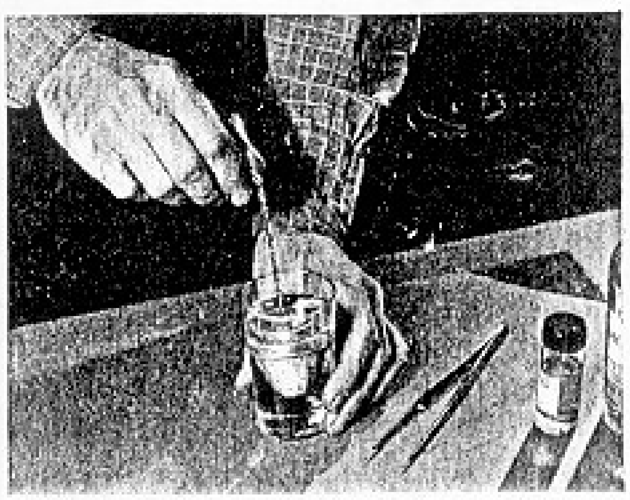
At the left is a magnified section of the anther of a flower, showing pollen grains. Below, section of dog liver after staining

are about as many different ways of arriving at the same destination as there are of dancing the big apple. Every worker has his pet fixing solution, his particular method of dehydrating, and his own way of doing this and that. But his results are usually little different from those of another worker who, compared with the first, seems to be doing everything wrong. That, perhaps, is the way of all science. Anyway, it indicates that the various steps about to be outlined may be varied considerably without causing a major disaster.

For one thing, we are going to junk some of the old, established steps, and

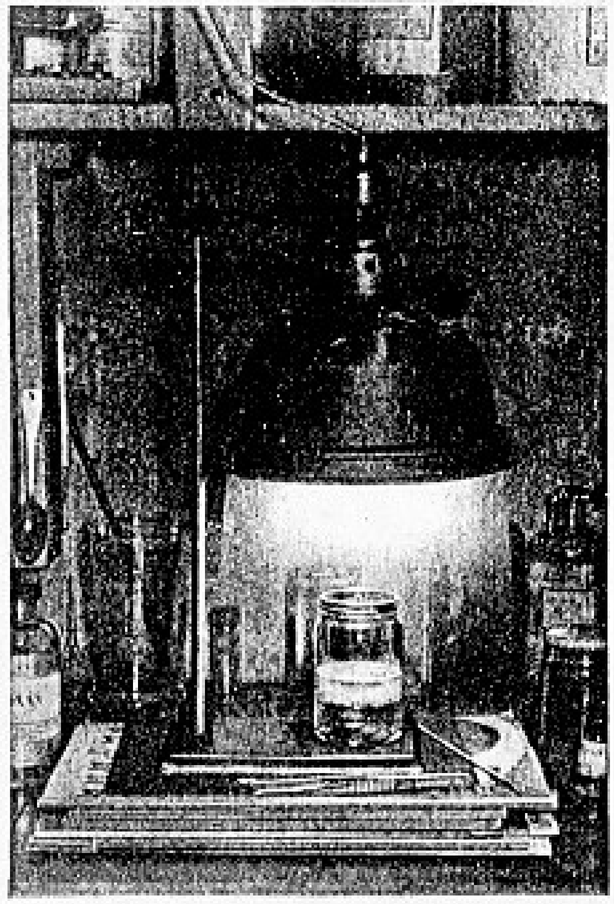


1 To make paraffin sections, first plunge the specimen into a fixing bath to kill and harden the cells forming its tissue



2 Remove the specimen from the fixer and rinse it in water. A metal tea ball is handy for this purpose, as illustrated

3 To dehydrate, dip the specimen into a vial of dioxan containing crystals of calcium chloride to absorb water



4 The specimen is then soaked in paraffin kept liquid by a heater made with an electric lamp and reflector

thereby save hours and hours of time. We can do this because of a rather remarkable, fairly new, and inexpensive substance called dioxan. The usual method of embedding tissue in paraffin for sectioning involves passing it through a number of alcoholic baths of increasing strength, until finally absolute alcohol is reached, for the purpose of extracting water. Fairly large pieces of tissue may have to stay in one bath for many hours, with the total time required running into days. Dioxan permits the thing to be done in one jump of three to twenty-four hours.

You can use almost any tissue for your first sectioning attempts. Beefsteak is easy to get and handle, and provides some interesting details in the finished section. The process of converting a sirloin into a microscope slide can be broken into steps, as follows:

Fixing. A fixer is a chemical solution that kills the cells of the tissue and fixes or hardens them so they will hold their shape during subsequent handling. Best results are obtained when the tissue from a freshly killed animal is plunged immediately into the fixer. Of course, you can't do that with the beefsteak, so you will have to disregard some distortion that might worry a scientist. Cut your meat into little cubes, say five to eight millimeters on a side, and drop it into about twenty times its volume of fixer.

There are many fixers, and no really universal one. But picric-alcohol will do for your beefsteak, and for a great many other animal tissues. To make it, mix 250 cubic centimeters of ninety-five-percent alcohol and 250 cubic centimeters of water (preferably distilled) and add one gram of picric acid. Leave small pieces of tissue in it a day, larger pieces two or three days.

Rinsing. Remove the tissue from the fixer and rinse it in a beaker of water. Small metal tea balls can be used to hold the tissue during such operations as this.

DEHYDRATING. After rinsing, place the tissue in pure dioxan. Nobody seems to know exactly just how long a given tissue need remain in dioxan for complete dehydration, but usually three to six hours will be enough. For a limited amount of material, you can keep the dioxan in a small vial. It is best to transfer the tissue to fresh dioxan once or twice during the dehydration period. Where considerable material is to be handled, and maximum use is to be obtained from the dioxan, a common method is to make up a dehydrating bottle.

Place some granular calcium chloride in the bottom of a jar, say one holding four to eight ounces of liquid; or you can use a phial holding an ounce or so, for small pieces of tissue. Fill the jar about one-sixth full of chloride. Next, insert a disk of fine wire mesh or a piece of gauze or other cloth. Then pour in dioxan until the container is about nine-tenths full. When you put a piece of tissue into this dehydrator, it rests on the screen or gauze, the dioxan extracts the water, alcohol, picric acid, and most other reagents from it, and the calcium chloride in turn takes up the water and other substances from the dioxan. Thus the dioxan is kept always free from water. When the chloride grains have soaked up so much water that they fuse into a solid mass, pour off the dioxan, filter it, wash out the old chloride and add fresh, and replace the dioxan. In this way, dioxan (which costs only about twenty-five cents a pint, anyway, container extra) can be stretched out over a surprising amount of work. Instead of calcium chloride, you can use calcium oxide to extract water from dioxan.

EMBEDDING in paraffin. Take the cubes of beefsteak from the pure dioxan, and place them in a bath consisting of one part dioxan and two parts melted paraffin. Keep at a temperature that will maintain the paraffin in a liquid state. Leave in this bath for about three hours. Then transfer to a bath of pure paraffin, and leave for another three hours. Some tissues may require longer. Also, in some cases you can omit the dioxan-paraffin bath, and go directly from dioxan to pure paraffin.

The paraffin should be specially prepared for microscopy. You can pur-

chase it at biological supply houses and similar places. Several grades are available, ranging from soft to hard. For general purposes, a medium grade, melting at about fifty-three degrees centigrade, will do.

To keep the paraffin melted, you can use an arrangement like that shown. An electric lamp, sixty to 100-watt size, is held in a socket provided with a reflector, and suspended above the beaker or jar containing the paraffin.

AFTER the tissue has been left in the pure paraffin bath for the required time, transfer it to melted paraffin held in paper molds, which hardens into rectangular blocks. These paper molds are made by folding rectangles of paper twice as long as they are wide, four by eight centimeters being a convenient size. Fold the rectangle lengthwise to form three strips of equal width. Then unfold and fold crosswise, also to form three equal strips. Unfold, and you have a rectangle in the center, surrounded by eight others. This center area becomes the bottom of the mold. Bend up the four sides until they are at right angles to the bottom, folding the corners back over the ends until they overlap. Then bend the ends down to form handles, and places to write the name of the object being embedded.

Pour melted paraffin (which, for best results, should be filtered through filter paper held in a metal funnel heated with a Bunsen flame) into the little paper molds, and transfer the pieces of tissue to them, one piece to a mold. When the paraffin begins to harden, you can move the tissue around with warm dissecting needles. Arrange the pieces so they are near the center of the paraffin block, and placed with respect to the direction of the cut to be made.

SECTIONING. After the paraffin has hardened, strip the paper from one of the blocks, trim roughly to shape by removing much of the excess wax with a knife, and cement the block to the paraffin-block holder of the microtome, merely by warming the holder and pressing it against the wax. Square the specimen with respect to the holder, so that you will obtain accurate cross sections or whatever other kind you wish to cut. With the beefsteak, it may not matter much, for the muscle fibers probably twist about in various directions. Trim off excess wax again if necessary, and insert the block into the microtome. With a sharp razor (a straight-edge type or a safety blade clamped rigidly in a holder that does not permit it to bend), cut the sections, making them as thin as possible.

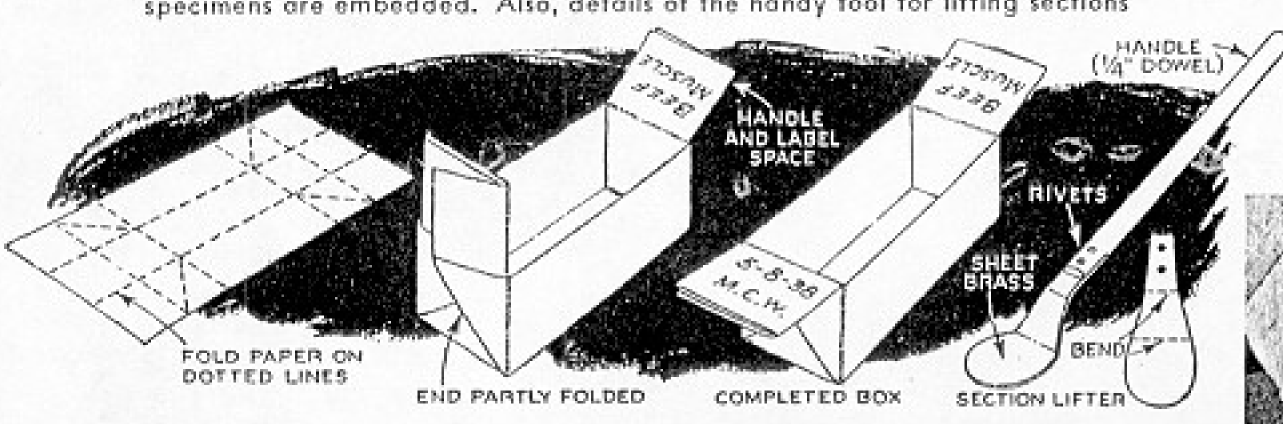
Perhaps the thin slices of paraffin (and the tissue) will curl. To straighten them, drop them into a beaker of warm water, where they will float. Do not use water warm enough to melt the wax. For handling the thin slices, a handy section lifter can be made by bending a piece of thin brass as shown in one of the drawings, and fastening it in a wooden handle.

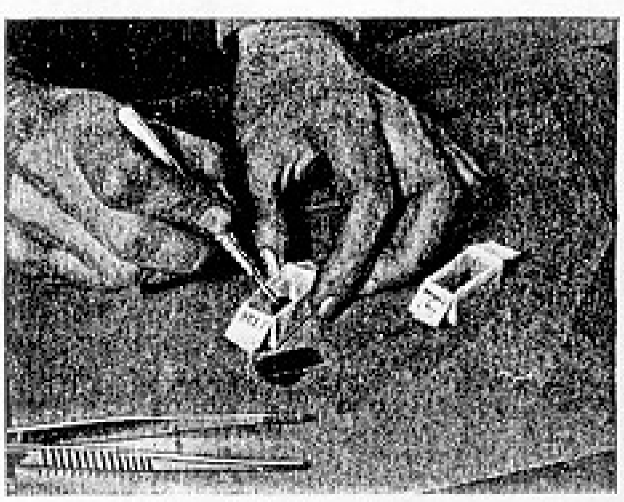
Cementing to slide. Prepare several glass slides by washing with a cleaning powder and smearing one surface with albumen fixative. To make this fixative, mix the white of an egg with an equal volume of glycerin, and add a generous pinch of salicylate of soda to prevent spoiling. For each slide, only a mere film, made as thin as possible by rubbing with the finger, is required.

LAY one or more of the flattened sections on an albumen-coated slide and place a few drops of water beside them, so that it flows beneath the paraffin and makes them float. Or, you can add the water first and then the sections. Warm very carefully over an electric lamp or a flame, until the sections become soft, (but do not melt), and flatten out. Drain off excess water, arrange the sections to the required position, and lay the slides away, in a horizontal position where dust won't collect on them, to dry. Let them dry twelve hours.

Removing paraffin. Place the slides on edge in a container of xylol for several minutes, or until all the paraffin has been dissolved away, leaving the sections adhering to the albumen.

How paper is folded to make molds for casting blocks of paraffin in which specimens are embedded. Also, details of the handy tool for lifting sections





5 Tiny molds, folded from paper as shown above, are used to set specimens into handy blocks of solidifying paraffin

6 Trim away excess wax and insert the block into your homemade microtome. Then slice thin with a razor blade

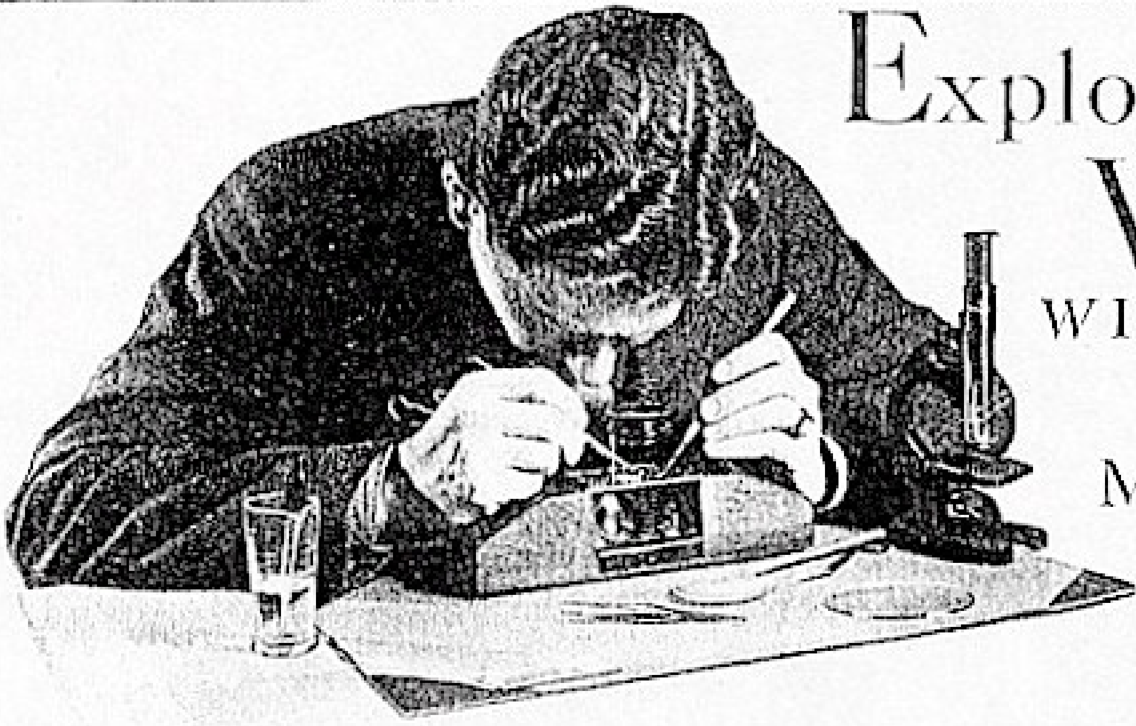
7 To cement a section to a slide, smear the glass with albumen fixative made by mixing glycerin with white of egg

8 With the section in place, dip the slide in xylol, as shown in the upper photograph, to dissolve the paraffin

Staining. If necessary or desirable, the sections, after removal from the xylol, can be stained. A common procedure where cells are to be made prominent is to stain with hæmatoxylin, which colors the nuclei blue or purple, and then with eosin, which colors the rest of the cell pink or red. Before staining with a water solution, remove the xylol from the section by washing in two changes of dioxan. It is best to use a prepared solution of hæmatoxylin, such as Delafield's. Put a few drops of the stain on the section for several minutes.

RINSE, and soak for several minutes in tap water to brighten the color. Then drop the eosin solution on the section for a half minute or so. A suitable eosin stain is made by dissolving about a tenth of a gram of the dry dye in twenty cubic centimeters of water. After staining, immerse the slide for a short time in pure dioxan, to remove water.

Mounting. The Canada balsam used as the mounting medium can be dissolved in dioxan, if it is necessary to thin it. Simply place the balsam on the specimen, and add a clear cover glass. When no xylol is present in the balsam, dehydration may continue after mounting, for the dioxan-thinned balsam will continue to take up water from the tissue. Balsam thinned with xylol can be washed from glass with water.



Exploring the World of Insects WITH YOUR MICROSCOPE

By Morton C. Walling

POPULAR SCIENCE MONTHLY JULY, 1936

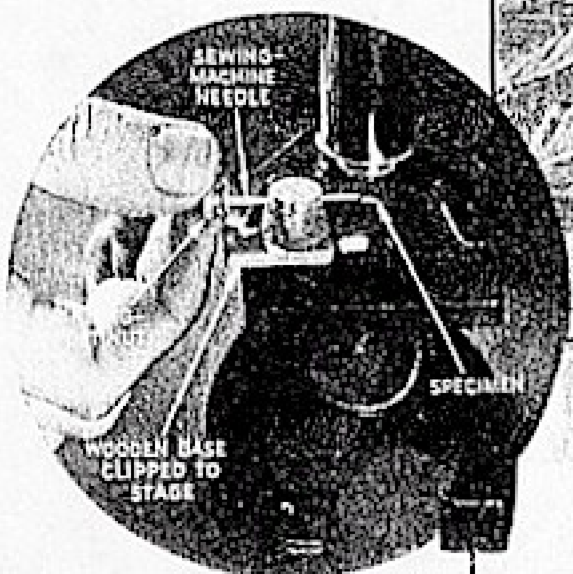
A dissecting microscope being used in removing the outer layer of a honeybee's eye

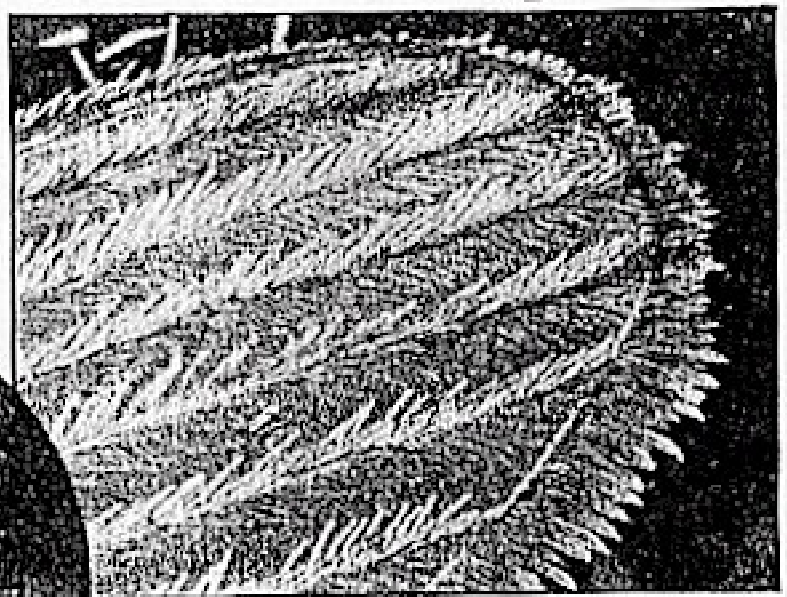
TURN the magic eye of your microscope into every corner of the world about you, and you will find no more entertaining objects than the insects. There is scarcely an insect foot, eye, or wing that, under the revealing power of lenses, does not become a thing of surprising beauty to the person seeing it for the first time, and an object surrounded by still unsolved mysteries to the microscopist who has seen it a thousand times before.

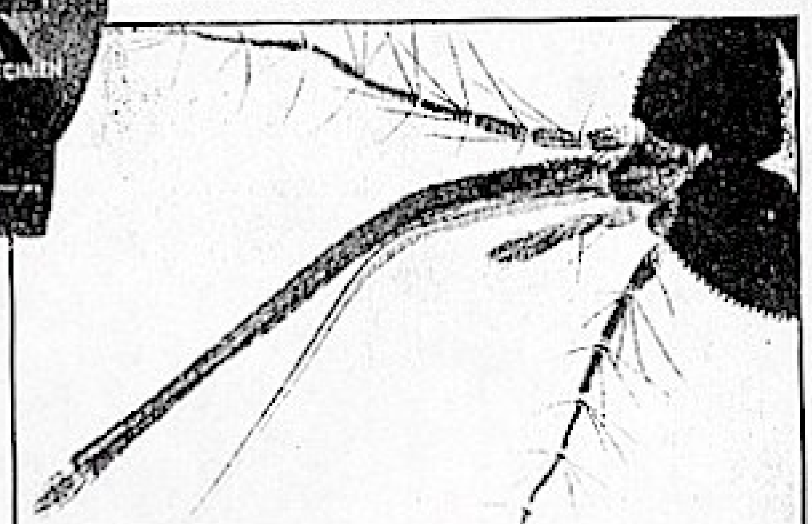
Insect bodies and wings often are clothed with scales and hairs, and various structures ranging in form between these two, of great beauty of form, color, and texture.

Capture a butterfly and rub one of its wings against a clean glass slide. If you fail to obtain in this way a collection of tiny scales, breathe on the slide to moisten it, and rub again. Also, clip a section from the wing and lay it on a slide, being careful not to rub off too many scales.

An insect scale, you will find, frequently resembles a plant leaf or, in many cases, a flat paddle with a handle that tapers more or less to a point. Most scales are marked with ridges and grooves that run either parallel to the stem or "handle," at right angles to it, or in a radiating pattern. These markings are very fine, especially in some scales.







A HOLDER FOR TURNING INSECT SPECIMENS

The simple device pictured above enables you to rotate subjects as you examine them. In the upper photomicrograph at the right is a wing tip of a mosquito, and below it is the insect's head. The black areas at right are compound eyes

The appearance of a small section of such wings as those of butterflies and moths, and parts of the bodies of some insects, when magnified fifty or so diameters, is somewhat like that of a shingle roof. The scales are arranged in overlapping rows, and each scale is attached to the wing by its tiny stem. You will find that the coloring, seen in such objects lies entirely in the scales, and that the part of the insect to which they are attached, as the wing of a butterfly, generally is colorless. Scales of various colors and hues are found on the same insect or the same wing. Some scales, as those of certain beetles, have a beautiful, metallic sheen

that is best seen by reflected light.

Scales seem to be, in structure, essentially dried cells whose walls have collapsed to form thin, more or less flat objects, something like a folded paper bag.

Insect hairs present a wide variety of sizes and shapes. Some are flat and sharp-edged, like the blade of a bayonet. Some are long, tapering, and pointed, like a keen lance. Others are equipped with knobs, often highly ornamental, along their shafts and at their tips, like war clubs. Still others have peculiar tips which resemble arrows or spearheads. On some insects, such as the diamond beetle, you can find various appendages ranging in form from hairs to scales, with many different shapes between these extremes.

Some hairs and scales look best when placed on the slide dry, and viewed by either transmitted or reflected light. Others should be mounted permanently in Canada balsam. To determine which method of mounting is best, without making slides of each kind, drop a little turpentine on some of the hairs or scales to be mounted. If this makes them more brilliant and clear, the balsam mount will be better. Otherwise, mount them dry in a cell formed by spinning a ring of shellac on the glass slide, or by cementing, with balsam, a thin washer of cardboard in the center of the slide. The specimens can either be placed loosely in the shallow depression thus formed, and sealed in by a clean cover glass; or a very thin layer of some adhesive such as balsam thinned with xylol can be spread over the cell bottom to hold them in place.

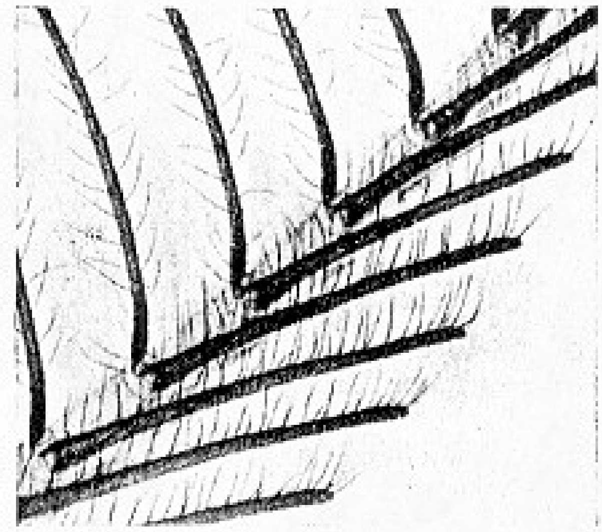
The antennas of many insects, particularly of certain moths, are objects of distinction and beauty. They range in form all the way from simple, hair-studded rods to elaborate plumes that might make an ostrich envious. So much do antennas vary—frequently even between males and females of the same species—that they are used by entomologists as a tag for identifying many of the various types of insects.

THE antennas of large insects generally are seen satisfactorily by laying them on a slide and examining them in air. For permanent mounting, balsam may be used. The specimens should, of course, contain no moisture. Simply drying them in air for a few days usually will suffice. For very small insects, it is best to mount the entire head. Some microscopists recommend that these delicate specimens be mounted in some fluid such as glycerin, rather than in balsam.

The remarkable mechanical ingenuity displayed by nature in the insect world can be seen nowhere better than in the wings of the various flies, beetles, locusts, and other flying insects.

Insect wings are structures of very great strength and extremely light weight. Examine a wing of a honeybee and a wing of a mosquito with your microscope. You will find that both are covered with stiff, tapering hairs or spines, some long and others short. The mosquito has, in addition, ridged scales arranged in rows along the wings and forming fringes around the edges, like exquisite embroidery work. Focus very carefully on the hairs of the bee's wing, moving the focusing knob slowly upward and then downward.

You will discover, in this way, that there are two sets of hairs, pointing in opposite directions. That is, some are on the upper surface, pointing toward the microscope objective, while others are underneath, pointing downward. This gives you a clew to the ingenious structure of the wing as a whole. It consists of two very thin, transparent membranes stretched, like the silk of an umbrella, over the stiff ribs or veins. The upper membrane is attached to the ribs, in most cases, more firmly than the lower, as you can determine by peeling off the membranes with dis-



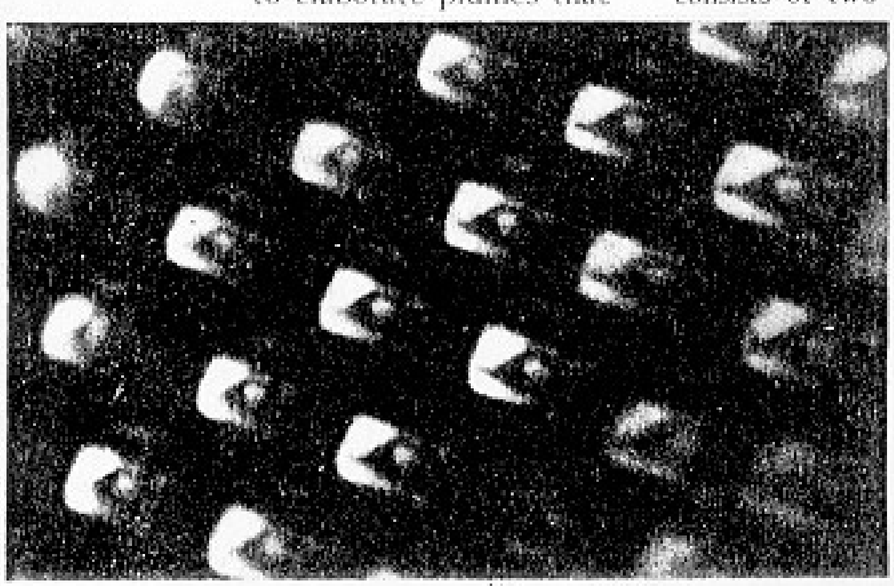
Part of the antenna of a moth, as seen by the microscope. Note the elaborate rows of hairs

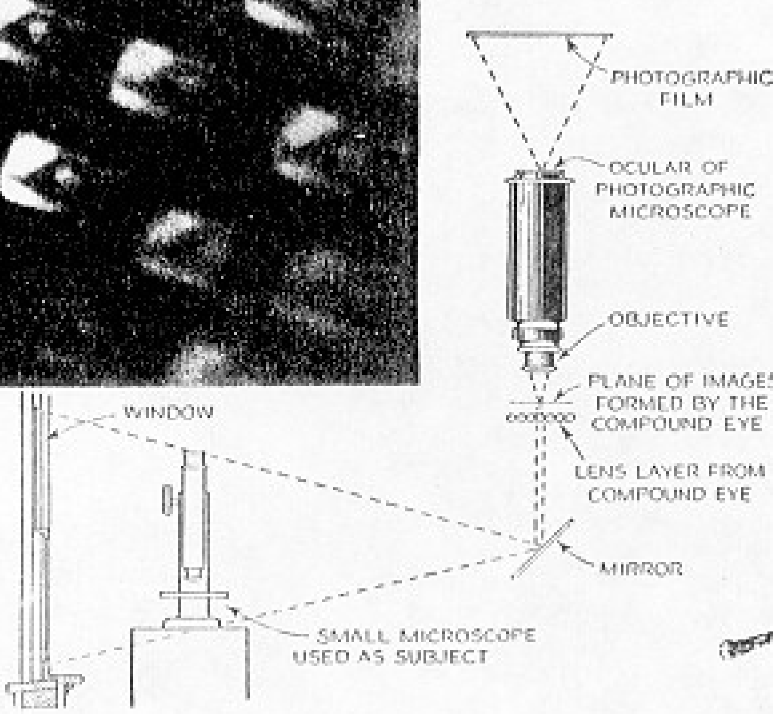
secting needles and fine-pointed tweezers.

When examining wings, particularly those covered with scales that glint with startling beauty when illuminated by reflected light at the proper angle, you will find it convenient to be able to turn the wing so that the angle can be varied. A handy tool for doing this is made by gluing a bottle cork about a half inch long to a short strip of thin wood, one end of which projects a quarter inch or so beyond the cork; and then pushing a sewing-machine or darning needle through the cork, near the top. Fasten the wing to the needle point with a bit of wax or glue, and clamp the device to the stage with one of the spring clamps, which engages the projecting part of the wood strip. A knob, for turning the needle easily, can be made by filling a knurled binding-post nut with solder and inserting the outer end of the needle into the hole before the solder hardens.

THE ingenuity of nature as displayed in the insect world crops out strongly in the hymenopterans, those insects whose winged members have two pairs of membranous wings in tandem. From an aerodynamic standpoint, it is desirable to have a large-area wing of unbroken surface; but from the standpoint of compactness, it is desirable to have a wing that can be folded back. Therefore the hornet, the wasp, and the honeybee, among others, have wings equipped with a strange-looking mechanism.

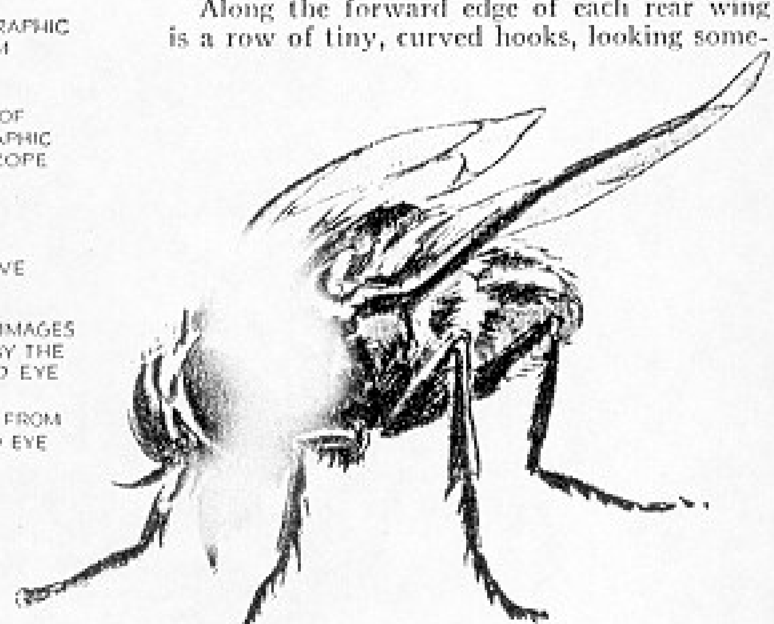
Along the forward edge of each rear wing is a row of tiny, curved hooks, looking some-



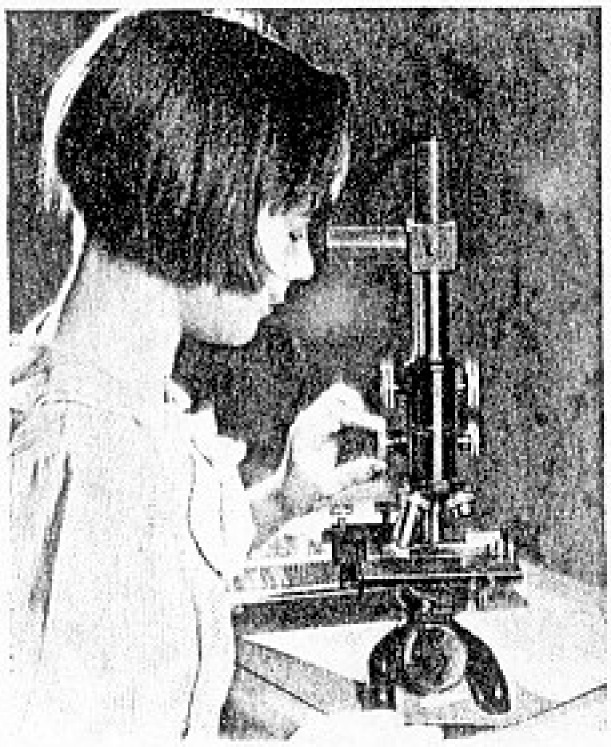


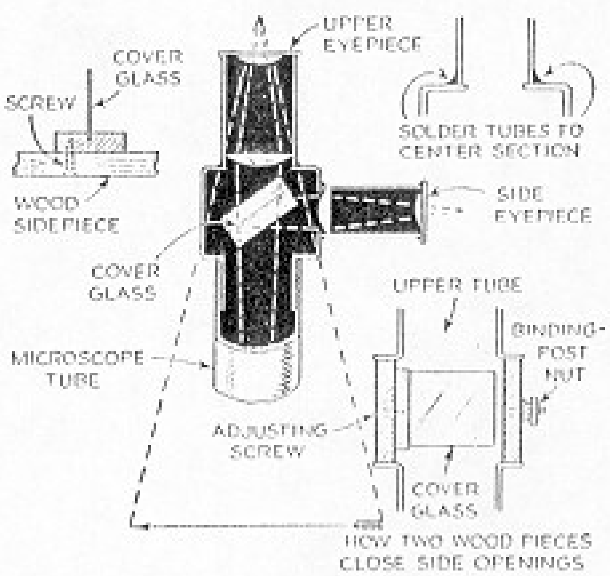
LOOKING THROUGH THE EYE OF A HONEYBEE

This is an actual photograph of the multiple images formed by the compound eye of a bee. The object viewed is a small microscope framed in a window. The drawing shows the set-up for making the picture



DOUBLE EYEPIECE LETS TWO PERSONS LOOK AT ONCE

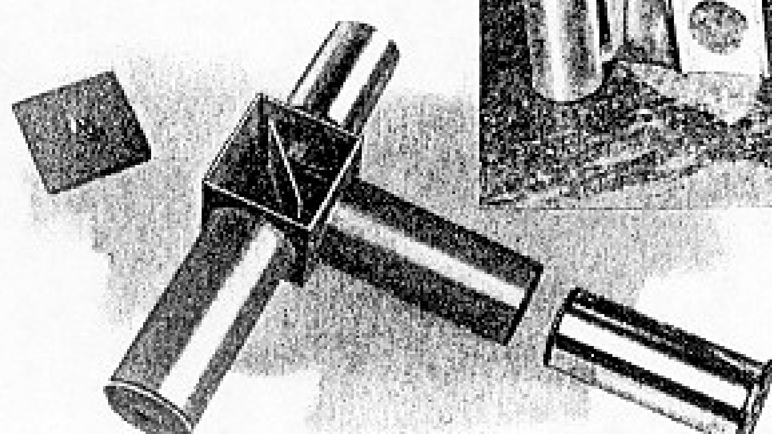




DID you ever want to look at an interesting object through your microscope and at the same time show it to a friend? You can do it if you have a demonstration attachment. This is simply a device, easy to make, which splits the microscope light beam into two parts, and sends each through a separate eyepiece.

You will need, in addition to an extra eyepiece, preferably of the same power as the one you have, a very thin (No. 1) cover glass and some tubes of cardboard or metal to receive the eyepieces and to fasten the attachment to the microscope. Construction is shown clearly by the illustrations. Paint all inside surfaces a dead black, using thin shellac to which drop black (Frankfort black) has been added, or special paint you can get from photographic dealers.

When using the demonstration attachment, one observer looks into the top eyepiece and the other into the side eyepiece. When first using the device, the two eyepieces must be adjusted so that they are the same distance from the objective, measured along the path of the light rays. This is done by focusing through the top eyepiece, and then, without moving the microscope focusing knob, sliding the side ocular back and forth until the image is sharp. Some loss of definition will be noticeable through the side eyepiece because of light being reflected from both surfaces of the cover glass; but usually this is not excessive if the glass is thin.



Assembly of three metal tubes and center section for demonstration eyepiece. At left is the complete attachment, with eyepieces, cover glass as beam-splitting mirror in the center, and the composition sidepiece

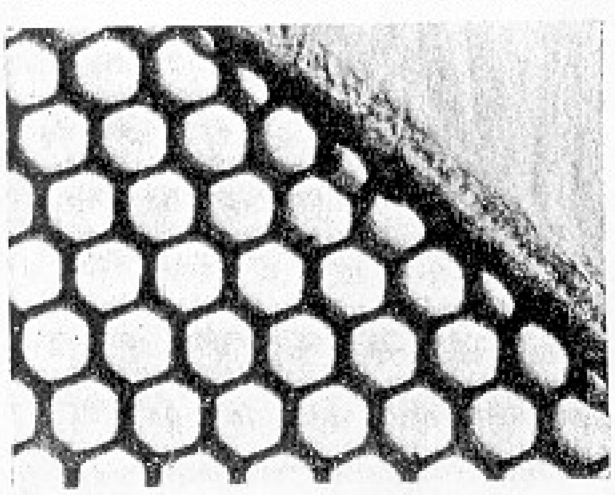
thing like the claws of a cat. The rear edge of each forward wing is curved over to form a groove. When the insect is at rest, wing sections on each side are folded back separately. But when the wings are extended for flight, the tiny hooks slide into the grooves ahead of them, securely locking the two sections together. This ingenious mechanism is perhaps seen best in a hornet, with the wasp and honeybee almost as good.

Wings of many insects, such as crickets, are equipped with sound-producing devices. The common house cricket has a drumlike area in its upper wings, bounded by a thick vein covered with horny ridges. Adjacent to this ridge in each wing is a notched "bow" resembling a file. The cricket produces its characteristic song, the microscope indicates, by rubbing these bows across each other, so as to make the drumlike area or tympanum vibrate.

Among the marvels of the insect world which the amateur microscopist can investigate at first hand is the compound eye. The house fly, the bee, the dragon fly, and other insects see their way about, not with a single pair of eyes, but with many, perhaps many thousand, tiny eyes, each as remarkable a piece of optical equipment as the microscope with which you view them. Collectively, these myriads of eyes occupy a considerable portion of the insect's head, and appear as two dark organs which frequently come together in front. In addition, insects usually have several single eyes, situated between the two compound ones.

If you place the head of, say, a mosquito on a slide and look at it, you will see the eyes as large, black masses through which no light passes from the mirror below. The edges of these black areas have a border made up of a series of little, glasslike bumps, remarkably even and uniform in shape. These are the outer surfaces of the numerous lenses which happen to lie in the plane of focus.

After an insect head has been allowed to stand in water until it has become soft and is easily torn apart, you can peel off the outer layer of the compound eyes. Scrape all of the black pigment from the inside surface, wash the layer, dry it, and lay it on a clean slide. You will find that it is a rather stiff, concave shell. To flatten it, make several cuts around the edge with a sharp scalpel, each cut extending a little way toward the center, and press the specimen flat against the slide with a cover glass. Look at it through the microscope, and you see a collection of tiny lenses. In most insects, these are six-sided.



Some of the six-sided lenses in an insect's compound eye. The outlining is black pigment

THIS is the corneal layer of tiny lenses that focus light rays entering the compound eye. It is one of the most wonderful pieces of mechanism that you will find in the insect world.

Each tiny lens is composed of two plano-convex lenses, arranged with their flat surfaces together. Why two lenses? The answer, the investigators say, is found in the fact that the refractive indexes of the outer and inner lenses are different, just as your microscope lenses, if they are corrected for certain defects such as the inability to focus colors properly, are made of two kinds of glass. Thus nature, millions of years ago, produced in the eyes of insects a lens combination that human optical experts only recently succeeded in duplicating. Each pair of tiny lenses is mounted at the big end of a tiny cone or pyramid. If you slice a compound

eye so that the cut is parallel to the axes of some of these cones—a task, incidentally, that requires considerable skill and careful preparation—you can see the construction of the cones. One way of making thin sections of eyes is to harden the head of a freshly killed insect for three or more days in two-percent chromic acid solution (about one gram of chromic acid to forty-nine cubic centimeters of distilled water). Then embed the head in something to hold it, like cocoa butter or paraffin, and slice it into thin sections, preferably on a microtome. (P.S.M [illegible] ne '33.

THE cones are surrounded by a black, light-proof pigment. Just behind the lenses of each cone the pigment extends inward to form a diaphragm, like the iris of your own eye. The lenses focus the image of objects within range, at the small end of the transparent cone, where it is joined to an optic nerve. Thus, the insect sees a complete image for each little eyelet in its compound eyes. The common house fly has some 4,000 of these tiny eyes, while the dragon fly boasts 24,000.

With a microscope, you actually can see the tiny images formed by each lens of a compound eye. Focus first on the lenses of the corneal layer mounted on a slide, in air; then rack the microscope tube back slightly, so that the objective focuses in the plane of the tiny images formed by some of the insect lenses. By tilting the substage mirror at various angles, you can center the images of such objects as a window across the room, your fingers held a foot or so from the microscope and between it and a lighted window, or an unshaded electric-lamp bulb. It is possible even to photograph the tiny images formed by the insect's eye, as in one of the illustrations accompanying this article.

It is not a difficult matter to obtain stings of bees, wasps, hornets, and the like for examination. Simply grasp the posterior tip of the freshly killed insect's abdomen with tweezers, and squeeze. If you do it right, the sting case will pop out where it can be grasped with another pair of tweezers. You will be surprised to find how hard it is, and how easily it slips out of the tweezers. Pull the sting away from the body. This usually brings some muscle fiber, and perhaps the poison sac. Drop some water on a slide and lay the specimen in it.

By careful manipulation with a dissecting needle, you can extract from the sting case the pair of tiny, barbed lancets that do much to make the insect's weapon as efficient as it is. The stings of honeybees and the like are not easily pulled out of the flesh which they have penetrated.

WHEN the insect "sits down," the lancets, propelled by powerful muscles, enter the flesh, guided by the grooved sheath. Then poison secreted by special glands and stored in the poison sac or reservoir, which you may be able to see on your specimen, flows down the sheath groove and along the barbed darts.

You can embed the darts and sheath in balsam immediately after drying them thoroughly, for permanent mounting; but if the poison sac and muscle fibers are to be preserved, they must be completely dehydrated in alcohol of increasing strength, before mounting.

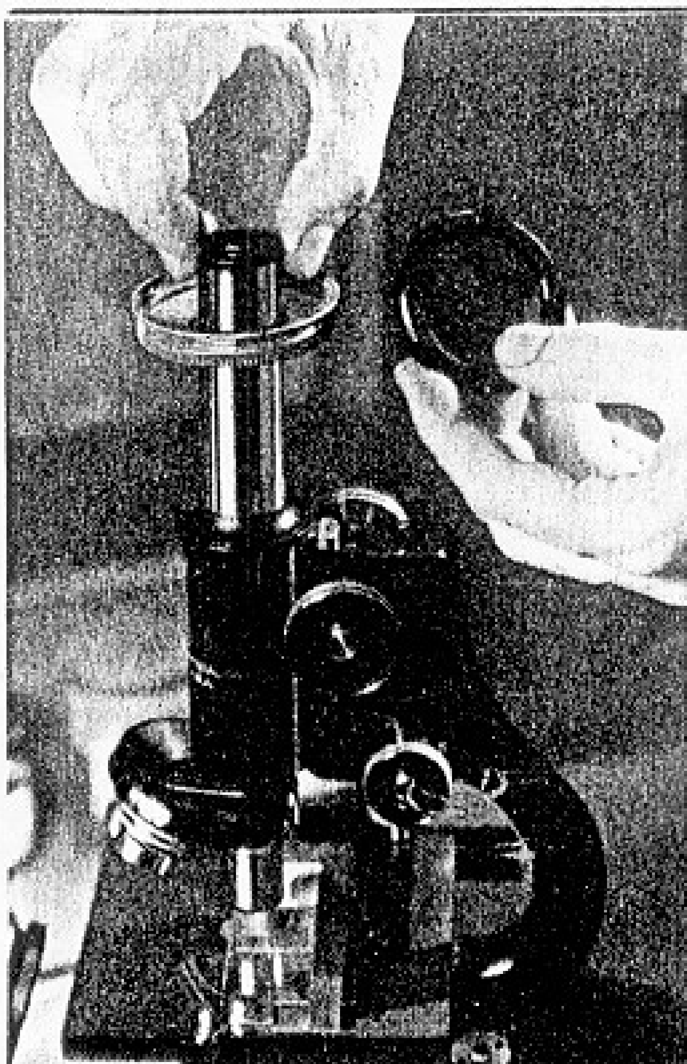
The number of interesting insect parts for study are countless. Two more suggestions for the beginner are: Feet of the house fly to show their unusual pads; the legs of honeybees, which have many surprising and odd devices, as scale-removing pincers, combs for cleaning, and baskets for carrying pollen.

Equip Your Microscope for POLARIZED LIGHT

Inexpensive Attachments Available to Amateurs Open the Door to a Wonderland of Beauty

POPULAR SCIENCE MONTHLY

DECEMBER, 1936

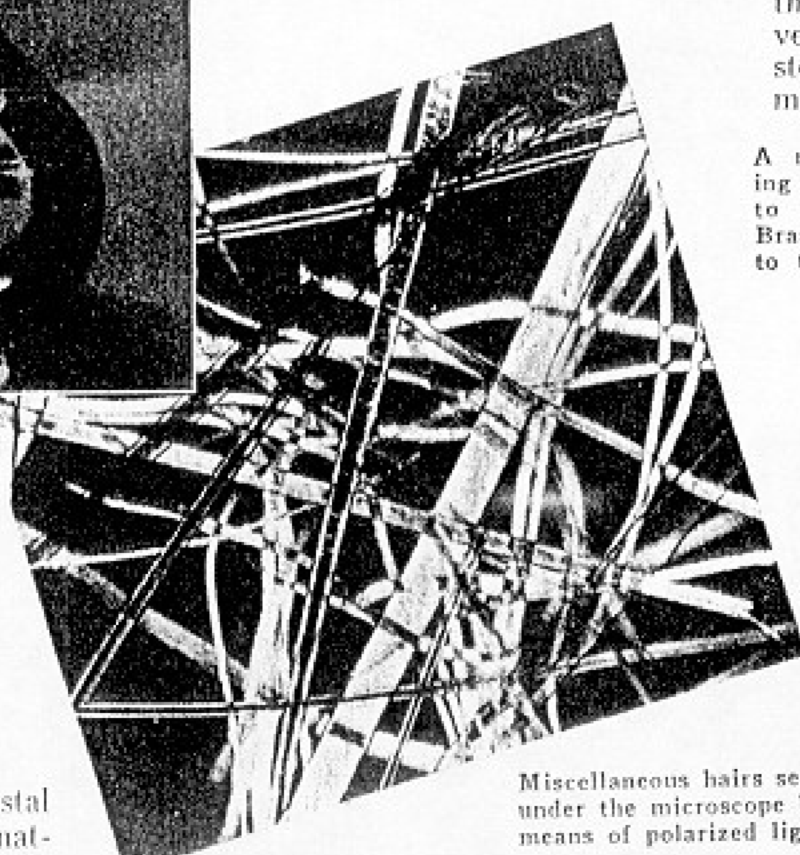


A metal jar lid, with a hole in the center large enough to receive the microscope eyepiece, makes a simple holder for a polarizing disk

By

MORTON C. WALLING

IF YOU have never seen a crystal of potassium chlorate illuminated by polarized light and magnified to about fifty diameters, you still have in store one of the greatest thrills to be found in the fascinating hobby of microscopy. The intermingled play of vivid colors and delicate tints, and the remarkable way in which the details of the crystalline structure are brought out, are things that cannot be described. You may have marveled at the color patterns produced in plant stems and other subjects by the use of specimen stains, but these are nothing to the new

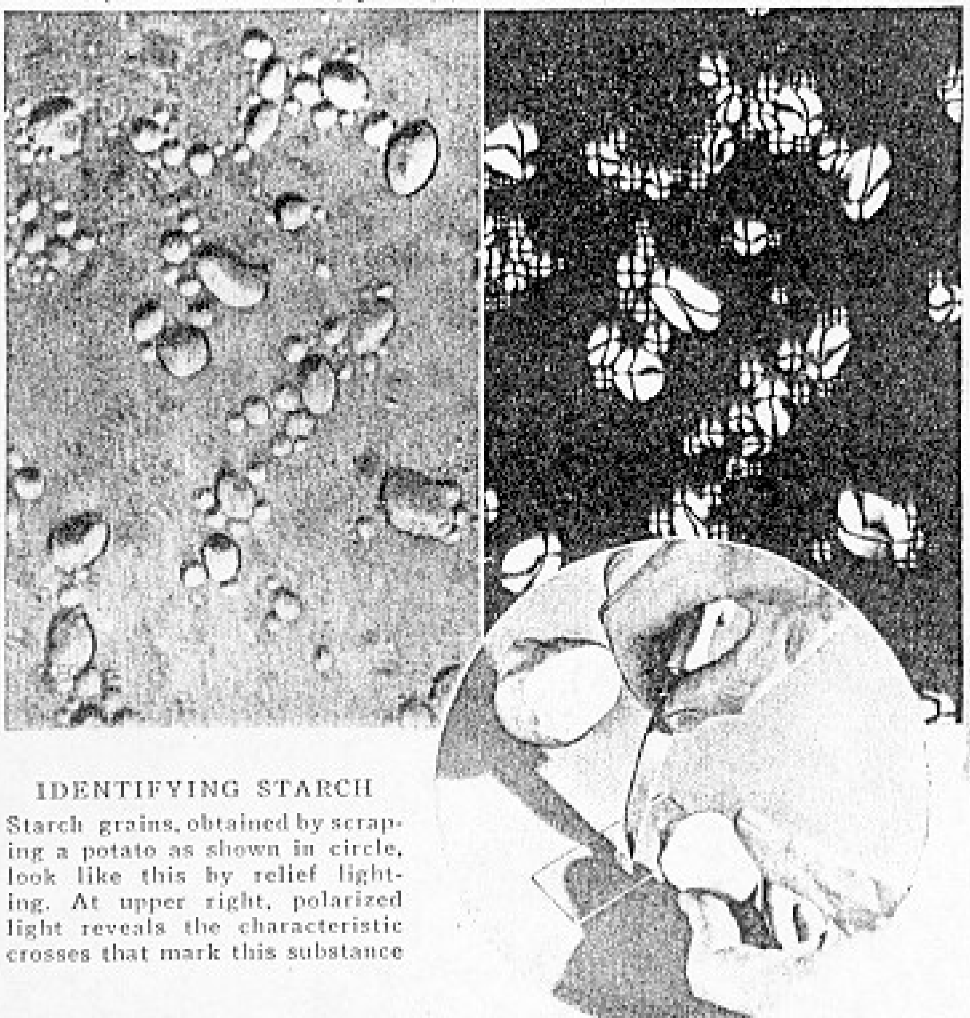


Miscellaneous hairs seen under the microscope by means of polarized light

A new-type polarizing disk being fixed to an illuminator. Brass strips soldered to the light hold it

beauty you can find in many subjects with the aid of simple polarizing equipment.

Some of the marvels of the polarizing microscope have been described already in this series (P.S.M. Oct. '34, p. 69); but since that article was published something has happened in the field of applied optics that has changed the picture, and opened a way for the introduction of inexpensive polarizing attachments that will increase enormously the capacity of any microscope. This new advance has been the perfecting of a polarizing material in the form of a sheet or plate (P.S.M., Apr. '36, p. 20), which is as easy to use with the microscope as conventional color filters.

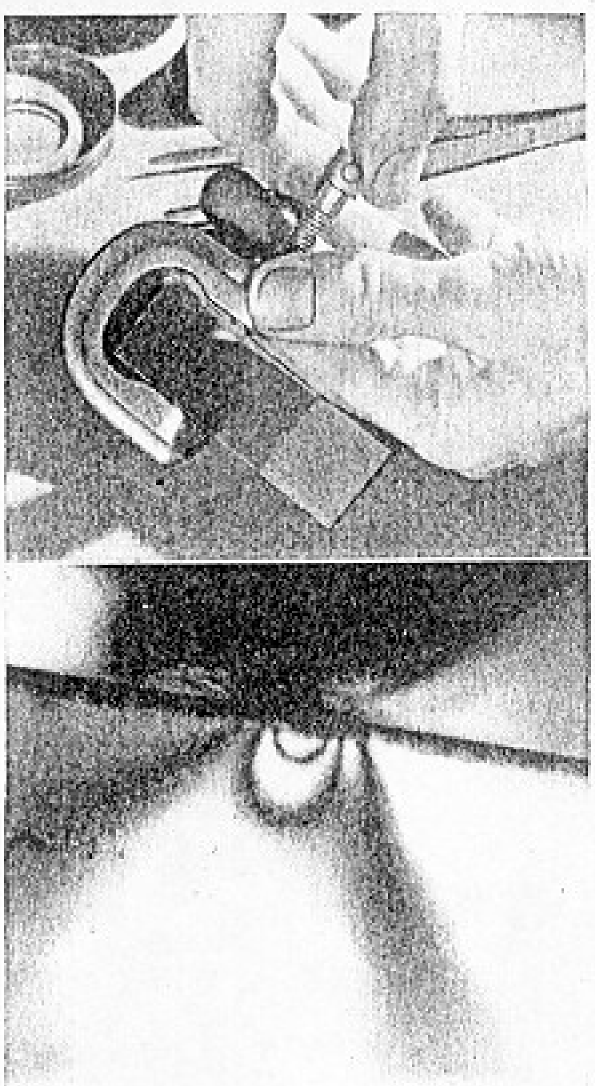


IDENTIFYING STARCH

Starch grains, obtained by scraping a potato as shown in circle, look like this by relief lighting. At upper right, polarized light reveals the characteristic crosses that mark this substance

WITH A DISSECTING LENS

Polarizing disks in use with an inexpensive dissecting microscope. One disk is held over the lens, and the other is mounted on the illuminator



LINES OF STRAIN IN GLASS

Squeezing a microscope slide in a clamp, as illustrated in the upper picture, sets up lines of strain which show up clearly under polarized light. Note the odd pattern of concentric arcs

But before taking up the methods by which a microscope can be converted for polarizing work, let's take a look at the behavior of light itself, and its action when polarized.

As you know, light is considered as being a series of waves traveling through the ether and vibrating at right angles to the direction of travel, each wave curving back and forth something like a snake traveling at full speed. Normally, these waves vibrate in every direction, resembling a tangled mass of squirming snakes all headed the same way.

Light vibrating in every direction behaves in certain well-known ways. But when only those vibrations traveling in one narrow plane are singled out and used to illuminate objects, remarkable things happen. Light vibrating in but one plane is said to be polarized, and the device used for sifting out such waves is called a polarizer.

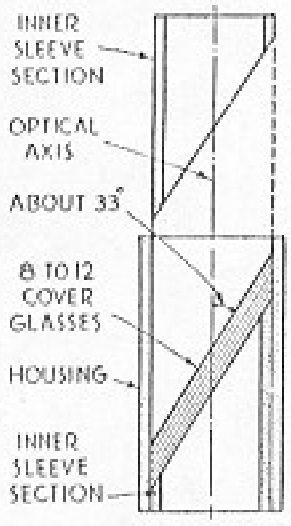
If you want to try a simple experiment showing just how a polarizer works, run a length of rope through a picket fence and fasten one end to some stationary object; then grasp the other end in your hand and wave the rope so that it snakes up and down in graceful waves. As long as you move your hand in a direction parallel to the pickets, the rope will behave nicely; but try to make the waves run from one end to the other when you vibrate it crosswise to the pickets! The rope in this example corresponds to a light wave.

If there is another picket fence a short distance from the first, the rope could vibrate with ease through both fences when the pickets are parallel; but if the cracks in the second fence were at right angles to those in the other, the vibrations along the rope would stop on reaching it.

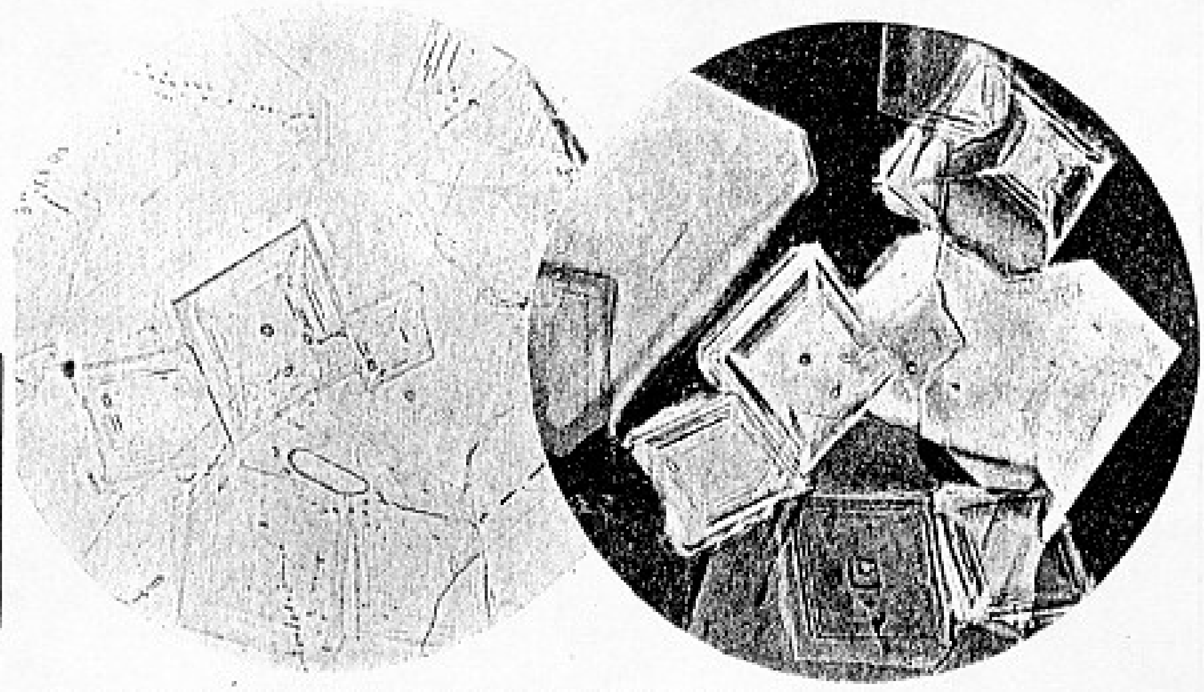
And so, in the polarizing microscope, there is a polarizer that screens out all wave lengths save those vibrating in one plane, and then a second polarizer, usually called an analyzer, exactly like the first, which sometimes lets the polarized light pass through, and sometimes holds the waves back, depending on its position with respect to the first polarizer.

Thus you see that polarizing devices are used nearly always in pairs in connection with the microscope, and that they can be adjusted so that the light that the first one passes is stopped by the second. The first polarizer usually is placed beneath the microscope stage or somewhere else in the beam of light illuminating the object, and the second polarizer, or analyzer, is placed above, inside, or below the eyepiece. One or the other must be mounted so that it can be rotated.

The value of this set-up comes from the fact that some materials behave in such a way that a beam of polarized white light falling upon them is split up into two beams that vibrate in planes at right angles to each other, and travel through the material at different velocities. These two beams get out of step as they pass through the material, so that some wave lengths as they emerge are polarized in one direction, and others are polarized at right angles to that direction. Now, it is difference in wave lengths that determines color; and so, when the second polarizing unit enables your eye to see only the rays vibrating in one plane, the crystal, or whatever the object is, appears colored. These colors frequently are very vivid and beautiful.



Details of a homemade polarizing attachment



ORDINARY CRYSTALS ARE TRANSFORMED INTO SPARKLING JEWELS

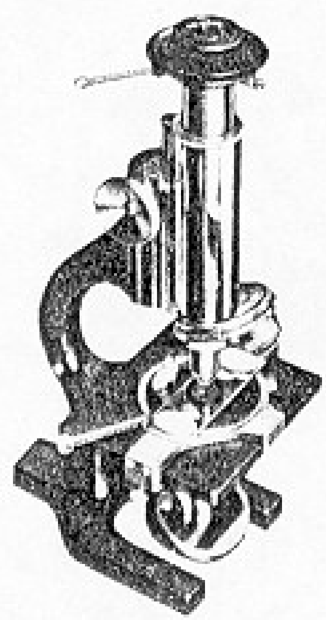
The photomicrograph at the left shows how crystals of potassium chlorate appear when viewed by ordinary illumination. They are all of one color and only moderately distinct as to structure. At the right, note the magic transformation that is brought about by the polarizing disks

As one of the polarizing units is turned, the colors change. A crystal or bit of crystal that appears in one color when the unit is in one position, will appear in the complementary color when the polarizer has been rotated ninety degrees. Thus, a blue crystal becomes yellow; a green crystal, magenta, and a red one, blue-green.

In the past, the most satisfactory way in which an ordinary microscope could be converted into a polarizing instrument was by the use of Nicol prisms. These prisms are cut from Iceland spar, a crystalline substance that is by nature double-refracting and therefore capable of splitting a light beam up into two polarized beams vibrating at right angles to each other. The crystals are cut and mounted so that one beam is lost, and only one passes through. The first prism (really a pair of prisms cemented together), called the polarizer, is placed usually below the stage, and the second one, the analyzer, is mounted above or below the eyepiece. The cost of the prisms put this method of getting polarized light out of the reach of most amateurs.

Said to be superior in some ways to the Nicol prism is the new polarizing material in sheet form. You have heard a lot about it lately, and you undoubtedly will hear a great deal more in the future, for it is adaptable to a great many things besides microscopy—such as photography, and the elimination of automobile-headlight glare. This material is more like the picket fence of our example than any other common polarizing device, for it consists of parallel lines of very fine crystals dispersed through a transparent material. Light can vibrate only parallel to the crystals in passing through.

The material is mounted between pieces of glass for protection, and these simple glass squares or disks are placed below the microscope stage and usually above the eyepiece, much as if they were Nicol prisms. You can purchase the polarizing plates in various sizes, up to nearly two inches in diameter, for ten dollars a pair; and you can obtain them especially mounted for microscope use, at the same price. The larger, unmounted form may be preferable to the microscope type because the polarizing plates can be used for other purposes, such as elimination of reflections in photography, and in the projection of images of objects by polarized light with a lantern or low-power projection microscope. Plans are being made to offer an amateur-size polarizing set that will sell for a fraction of the cost of present equipment.



A microscope fitted with a special polarizing eyepiece attachment. This instrument also has a revolving stage, which is useful for studying minerals and can be attached to many microscopes of the amateur type

Simple and inexpensive polarizing attachments of remarkable efficiency can be made from nothing more than two dozen or so clean cover glasses and a quantity of glue and cardboard tubing. It happens that a ray of light passing through a sheet of glass at an angle of about thirty-three degrees to its surface is polarized, one beam passing through the glass and the other being reflected from its surface at right angles to the first. The polarizing effect with a single sheet of glass is not complete; but when several pieces are placed together, almost complete polarization can be produced.

SO, TO make a simple polarizer and analyzer, you merely mount two stacks of cover glasses so that they are at an angle of about thirty-three degrees to the axis of the microscope lenses, and arrange one of the units so that it can be rotated. From eight to twelve cover glasses will be sufficient for each unit. Clean the glasses well with a household cleanser. Make from cardboard, rolled paper, or (if you have a lathe) brass, two tubular housings for the glass pieces. One of these is to be mounted directly under the hole in the microscope stage if there is room, or somewhere in the beam of light falling on the substage mirror if there is not. The analyzer housing can be made so that it will fit inside the microscope tube directly below the eyepiece, or so that it will slip over the eyepiece; or the cover glasses can be mounted inside the eyepiece, just below the upper lens. The exact form of the housings will depend on the microscope you have.

If you use square cover glasses, the cardboard housings can be rectangular in section. For round housings, oval-shaped glasses are best. Make the housing in two parts, consisting of an inner sleeve that fits snugly inside an outer sleeve. Remove the inner one and cut it in two along a line that makes an angle of thirty-three degrees with the axis. Cover one half of the inner sleeve with glue and slide it into the outer one, drop the cover glasses in place, and then glue the second half in place. The glasses should be tilted at the proper angle, and held securely in place. Paint the inside of each housing with black India ink, to kill reflection.

THERE is almost endless variety to the things you can examine by polarized light. You will find that some substances, such as sugar, do not affect the light ray as it passes between the two polarizing units. Therefore, when examined through crossed polarizers—that is, through units at right angles to each other with respect to their polarizing action—the entire microscope field appears dark. But introduce into such a field a double-refracting substance, such as a bit of cellulose, or a crystal of potassium chlorate, and you see the substance clearly—and often with surprising brilliancy and color—against a darkened background when the polarizers are crossed.

Now for a few excursions into the wonderland opened to your microscope by polarized light:

Cellulose, the common plant material, shows very brilliant polarization when the polarizing units are crossed. Examine some cotton fibers and a bit of lens tissue paper by ordinary and then by polarized light. The appearance of cellulose in polarized light often is used to identify it when it appears among other materials. Examine a section of plant stem by polarized light.

Scrape a bit of fresh-cut potato into a drop of water on a slide, add a cover glass, and examine the starch grains by ordinary illumination. Then look at the grains by polarized light. What a striking transformation! In each grain you see a little, dark cross. This cross is characteristic of starch, and enables scientific sleuths to identify starch when found among other substances that have similar appearance in ordinary light. Starch from different sources, such as tapioca, wheat, and potatoes, can be distinguished.

To examine human hair, obtain a white hair so that the pigment will not interfere. Cut it into short lengths, and mount it on a slide in balsam or water. Remove grease from the hair by washing it in benzine or carbon tetrachloride. In polarized light, the hair sections possess amazing beauty.

Look at the crumpled transparent wrapper from a package of cigarettes or chewing gum by polarized light. The colors produced are striking and beautiful. You can make such examination at the lowest power of your microscope—or, in fact, without any magnification at all.

THE structure of bone, as revealed by examination of thin slices, can be seen with increased clarity in polarized light. Bone sections suitable for the microscope are made by cutting a piece of beef bone or other bone as thin as possible with a saw, and then grinding the surfaces smooth on an abrasive stone lubricated with water. The section is held while the second surface is being polished, by mounting it on a glass slide with hot balsam. Use a fine razor hone for the final polish.

Of the hundreds of crystalline materials that appear with remarkable beauty in polarized light, few are more awe-inspiring than potassium chlorate. Obtain some of this salt from a drug store—you will need only a pinch—and dissolve it in a few drops of warm water. Put some of the water on a slide, spread it out in a thin layer, and let it dry. Many small crystals will form. Examined with ordinary light, the crystals are all of one color, and only moderately distinct as to structure. But when you look at them with the polarizers, you find yourself gazing upon a collection of jewels more gorgeous than any that ever filled a royal treasure chest. Each tiny crystal blazes forth in startling color, and it seems as if each crystal has its own peculiar hue. In fact, many of them exhibit several different colors at once. Rotate one of the polarizing units slowly, and you see this chemical jewel box undergo a complete color transformation. The crystals, when perfectly dry, can be mounted under a cover glass in balsam. Many common crystalline substances afford materials for striking polarization studies.

CERTAIN minerals, when obtainable in properly prepared sections, are very beautiful in polarized light. In fact, it is with the polarizing microscope that science has unearthed many of the secrets of the mineral world. Thin sections are made by grinding pieces on abrasive stones, in a manner similar to that employed for bone. Among the better minerals for the purpose are granite, marble, asbestos, selenite of various thicknesses, agate, and quartz felsite.

Among animal substances, in addition to bone, you will find it worth while to examine sections of hoofs of horses or other animals, and sections of horns of oxen or sheep; quills from feathers, fish scales, raw silk, and wing cases of various beetles also make interesting subjects.

One of the most valuable properties of polarized light is its power to reveal the lines of strain produced in glass, celluloid, and other transparent materials. It is generally known that glass may be under a strain because of pressure or uneven cooling, but unless polarized light is available the regions of strain cannot be seen.

Sometimes a microscope slide that has not been annealed properly will cause trouble when used with the polarizer. To deliberately create strain in a slide, heat it carefully so that it becomes red-hot in one spot, and then allow it to cool. When examined by polarized light, the lines of strain set up by the heating and cooling are clearly visible. In a similar way, you can see the strains produced in a glass slide by pressing against the edge with your finger nail!

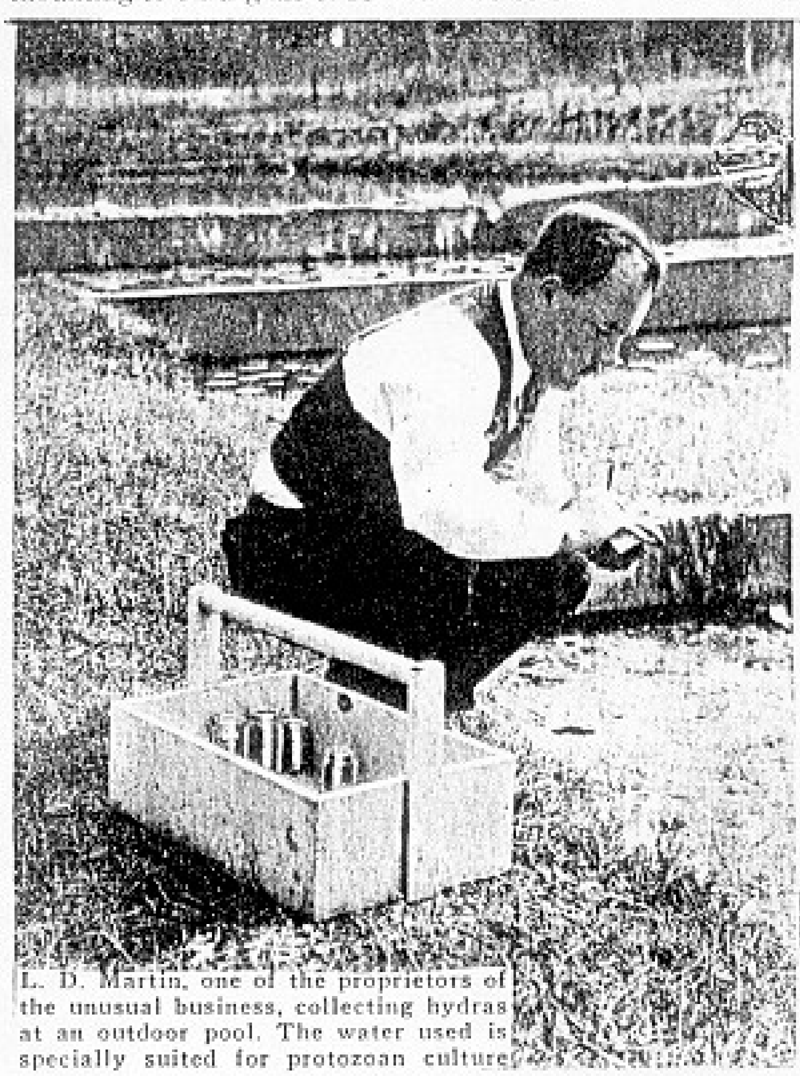
PRINCE RUPERT drops show in beautiful colors and lines the presence of strain. These drops can be made by heating a thin strand of glass, drawn from a piece of tubing or rod, with a blowtorch and letting the drops of molten glass fall into a tumbler of water. Most of them will break into small fragments when they plunge into the water, but a few will come through unbroken. These few are subjected to tremendous stresses by the sudden cooling, and examination with the polarized light will show the resulting strain. Be careful in handling the Prince Rupert drops, because they have a way of exploding at the most unexpected moments. Keeping them in a glass phial is safest, and they can be examined without removal.

You may find it interesting to cut out little celluloid models of bridges and other objects and see how the strains are distributed when they are placed under load. Transparent celluloid shows areas of strain clearly in polarized light. Because of this fact, engineers have learned much about building skyscrapers and bridges by actually watching the behavior of celluloid beams and columns under various loads.

Microscopic Ranch

RAISES TINY ANIMALS FOR THE LABORATORY

POPULAR SCIENCE MONTHLY APRIL, 1937


L. D. Martin, one of the proprietors of the unusual business, collecting hydras at an outdoor pool. The water used is specially suited for protozoan culture

WITH finger bowls for grazing ranges, one of the strangest stock farms on earth, near Elon College, N. C., produces millions of microscopic animals every years for use in biology classes in schools from coast to coast. Two former Elon professors, Dr. T. E. Powell and L. D. Martin, have operated the protozoan ranch for more than ten years. They started in 1926 in a shed purchased from a shoemaker. Since then, they have expanded until today they have a complete biological supply house, with 135 acres of land and a main building 200 feet long. Natural springs, flowing from beds of disintegrated granite, supply the water for the cultures. This water appears to make the animalcules grow larger, keep cleaner, and stand shipment better. As many as 1,000 heavy glass finger bowls, each holding a separate culture of amœbas, are sometimes stacked on tables in a room kept at a constant temperature of from sixty-eight to seventy degrees F. by thermostatic control. The "round-up" is accomplished with medicine droppers, the amœbas being sucked from the bottoms of the finger bowls and packed in containers in varying quantities. Hydras, another common kind of protozoan, are raised in outdoor ponds.

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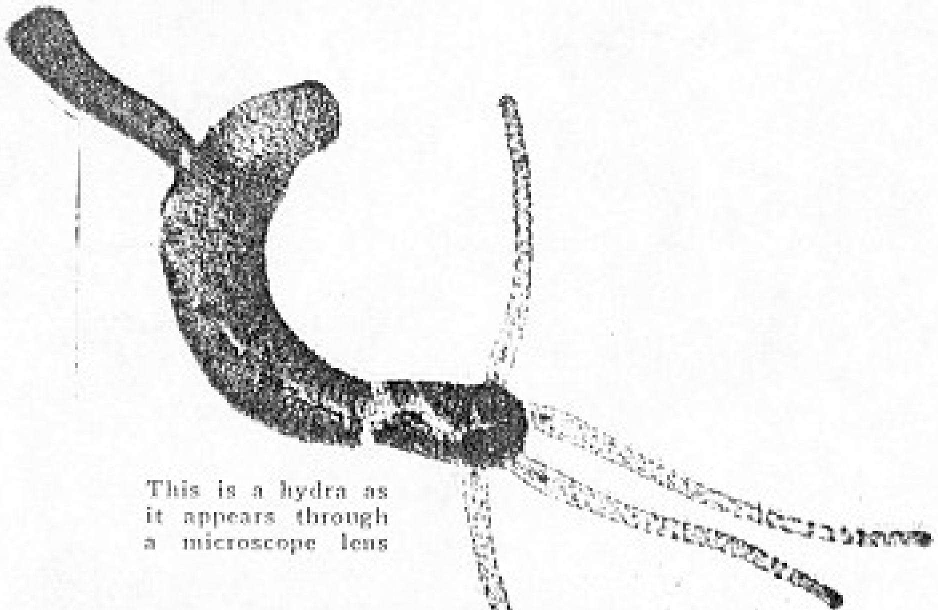
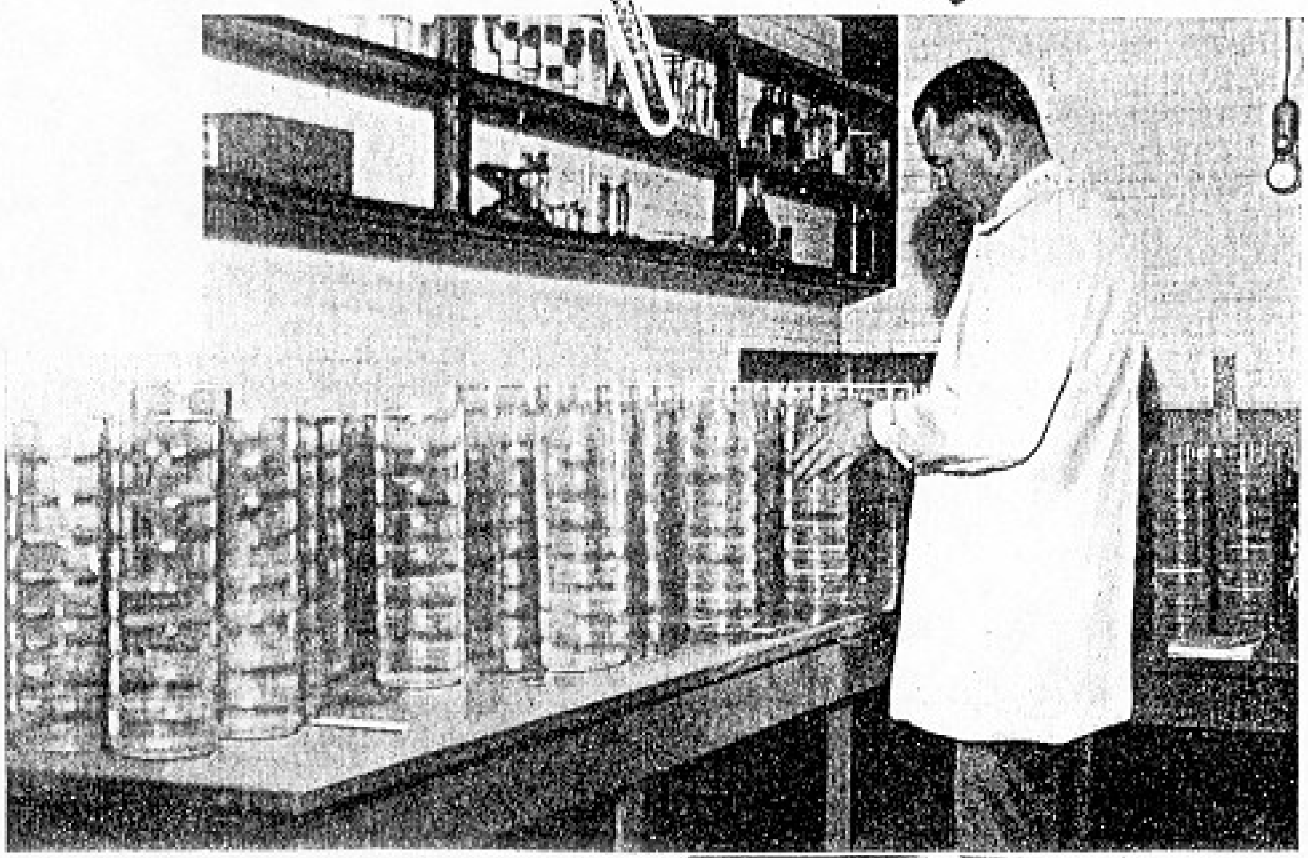
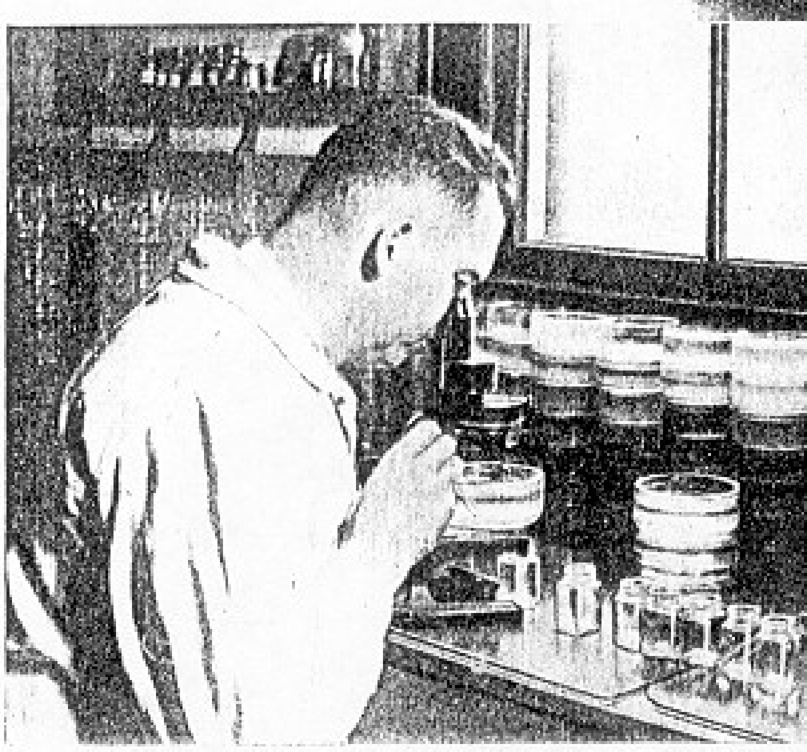


This is a hydra as it appears through a microscope lens

And this is an amœba. Millions of them are sold for student use



Dr. T. E. Powell at work in the amœba room, where as many as 1,900 finger bowls provide grazing ranges for the minute animals. They grow to salable size in three to six weeks



The great "round-up": at the left, amœbas are being collected from a bowl for shipment. Above, using a medicine dropper to suck hydras from the underside of a lily leaf

Looking at BACTERIA Through Your Microscope

Invisible Plants That Destroy Human Life, and at the Same Time Make Life Possible, Provide Fascinating Subjects for Study

By MORTON C. WALLING

POPULAR SCIENCE MONTHLY DECEMBER, 1937

If your instrument is not fitted with a substage diaphragm, you can improvise one that will improve its performance considerably

DESTROYING life wherever they can, yet making much life possible, bacteria are among the most fascinating of all the minute things on which to turn your microscope. These infinitesimal objects, classified by science as plants, are essential to innumerable forms of life. For even while bacteria are spoiling our food, they are busy manufacturing chemicals necessary to natural food production; and while they are causing the most deadly diseases that afflict mankind, they are preventing disease from wiping man from the face of the earth. They are at once among our best friends and our worst enemies.

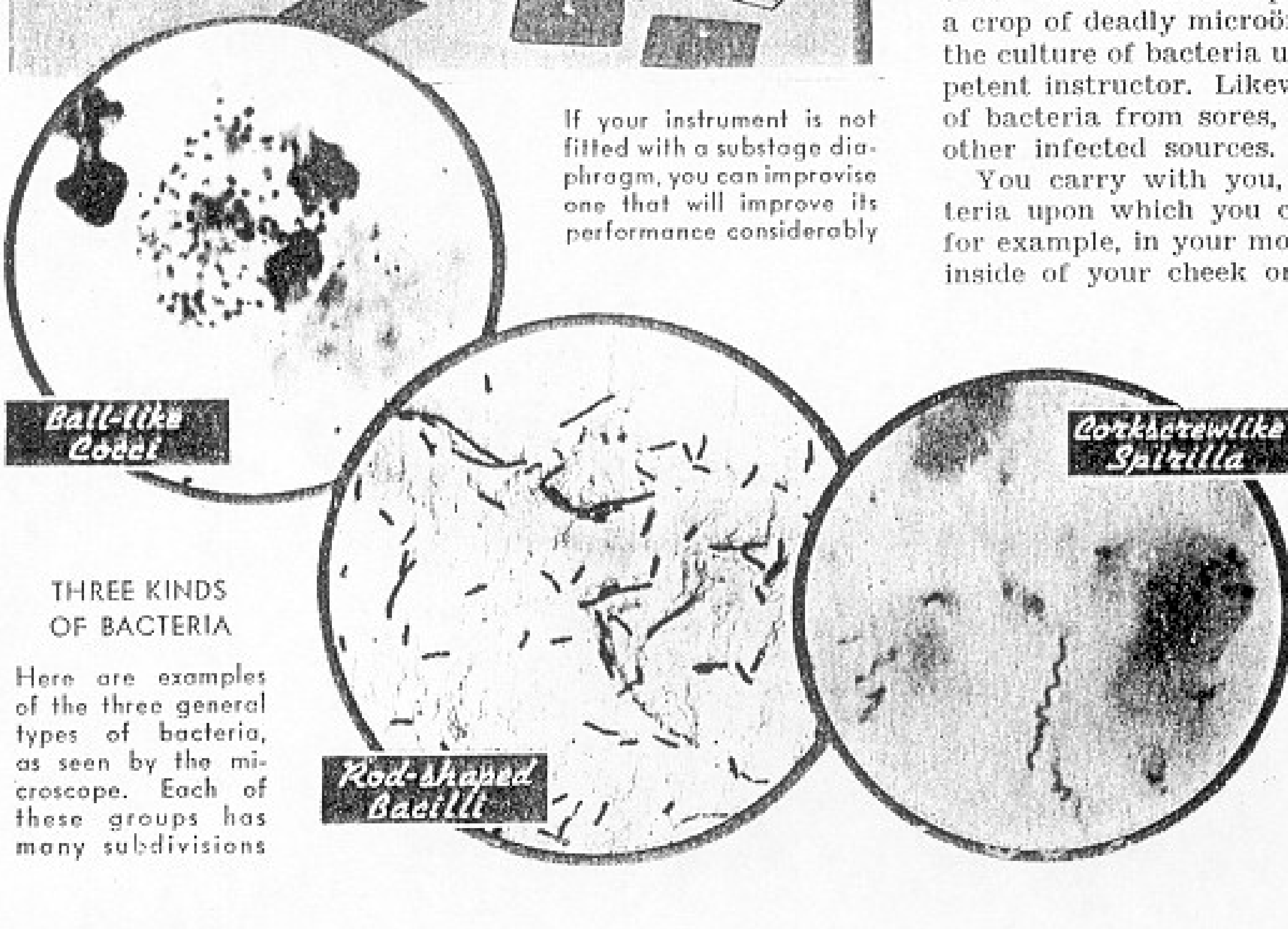
Biologists liken them in respects to fungi. They are close relatives of the algæ. Often you will hear them referred to as germs or microbes. Strictly speaking, however, "bacteria" is the proper name for them. Although some diseases, malaria for instance, are caused by tiny animals called protozoans, the majority of our most familiar and most dangerous illnesses are the result of poisons produced by bacteria growing in our bodies.

For detailed study of bacteria, a high-grade microscope having a substage condenser and oil-immersion objective lens, and magnifying 1,000 diameters, is desirable. However, it is entirely possible to see the larger bacteria at magnifications of a few hundred diameters with the better grade of amateur microscopes, although considerable patience may be required in preparing the specimens, arranging illumination, and focusing.

It is well to insert a warning here: Disease-causing bacteria can be more dangerous than T.N.T., if improperly handled. The pathogenic kind cause diseases like diphtheria, tuberculosis, and boils. Fortunately, there are enough harmless bacteria available to make it unnecessary for the amateur microscopist to experiment with the dangerous ones. Because of the possibility of unintentionally raising a crop of deadly microörganisms, you should not undertake the culture of bacteria unless you are working under a competent instructor. Likewise, do not attempt to make slides of bacteria from sores, the mouths of diseased persons, or other infected sources.

You carry with you, wherever you go, billions of bacteria upon which you can draw for specimens. They are, for example, in your mouth. To obtain a supply, scrape the inside of your cheek or the surface of your teeth with a clean fingernail or the broad end of a toothpick, and transfer the accumulated material to a slide, to be treated as described presently. Other sources of bacteria for study include stagnant water, the water from hay infusions, manure and other animal excreta, buttermilk, sour milk, sweet milk (whether pasteurized or not), and soil from the garden. Usually you can obtain a considerable collection simply by touching the tip of your tongue to a clean slide.

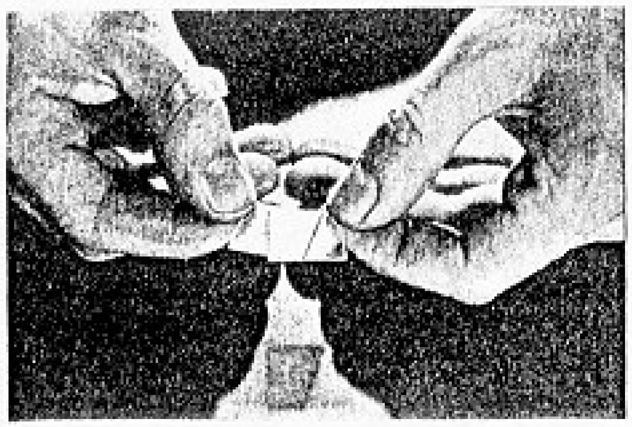
The ability to see bacteria well depends largely on the preparation of mounts, particularly



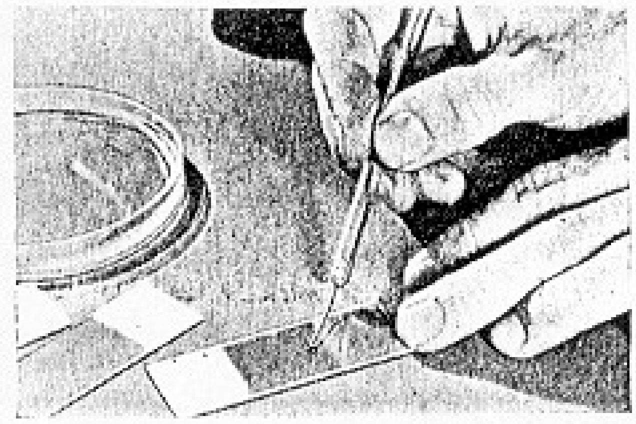
THREE KINDS OF BACTERIA

Here are examples of the three general types of bacteria, as seen by the microscope. Each of these groups has many subdivisions

Several forms of bacteria from the human mouth. Note the odd chainlike pattern

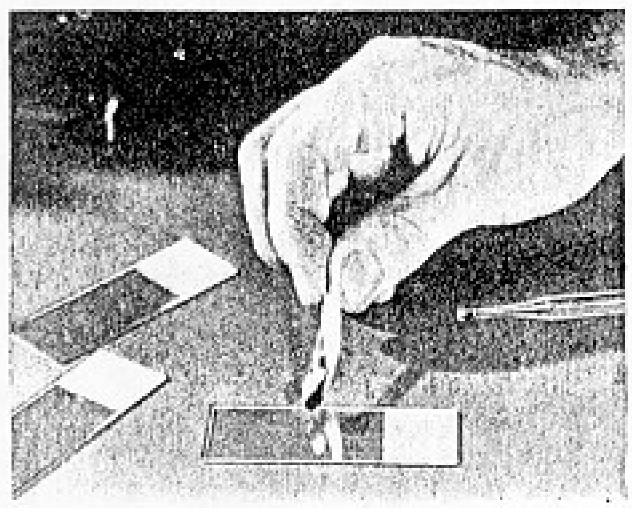


1 Liquid containing specimens can be spread by rubbing it between two pieces of glass

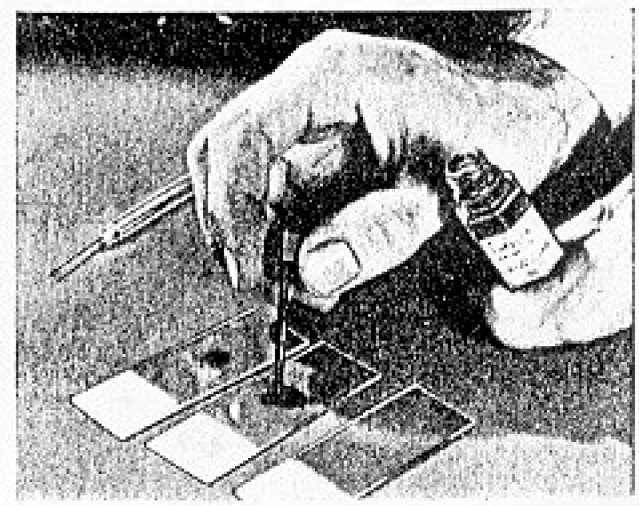


2 Another way is to smear it directly on a clean slide with the aid of a wire loop

3 To kill the tiny plants, burn a few drops of alcohol over them, as illustrated below



4 A stain is applied with a medicine dropper to make the details stand out more clearly



5 After rinsing, a cover glass may be added if desired, and sealed with Canada balsam

their staining. Some workers spread them in a thin film on thin cover glasses which later are inverted and mounted on slides. Others mount them directly on slides, and may or may not protect the preparation with a cover glass.

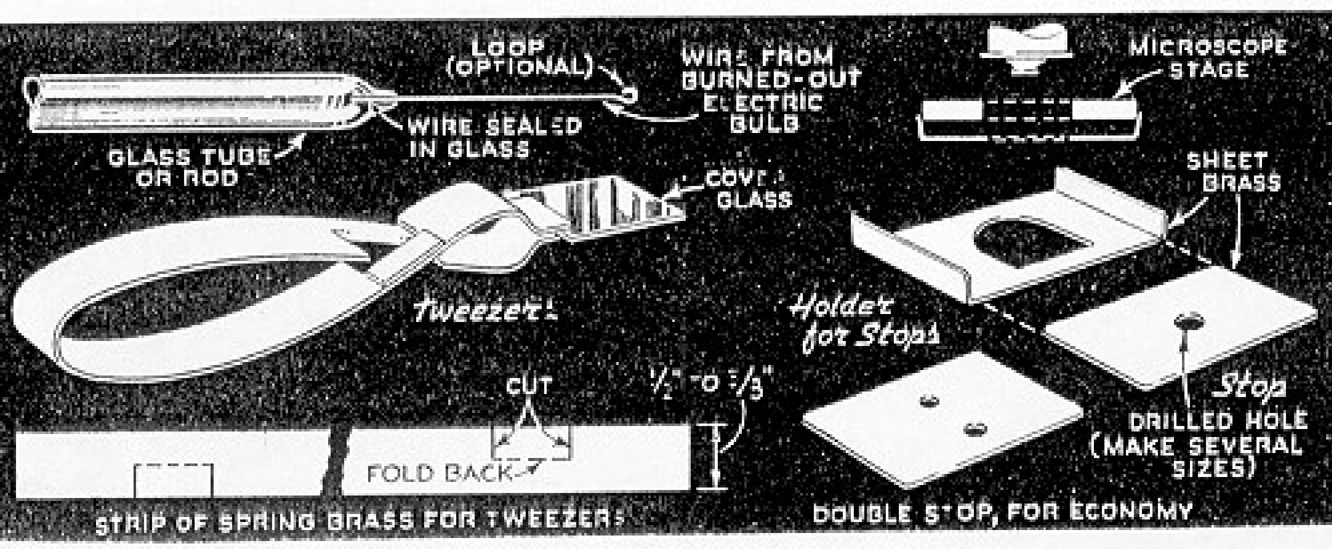
First of all, have your slides and cover glasses absolutely clean. Scour them thoroughly and wipe them with a soft, greaseless cloth such as a Turkish towel or some similar material.

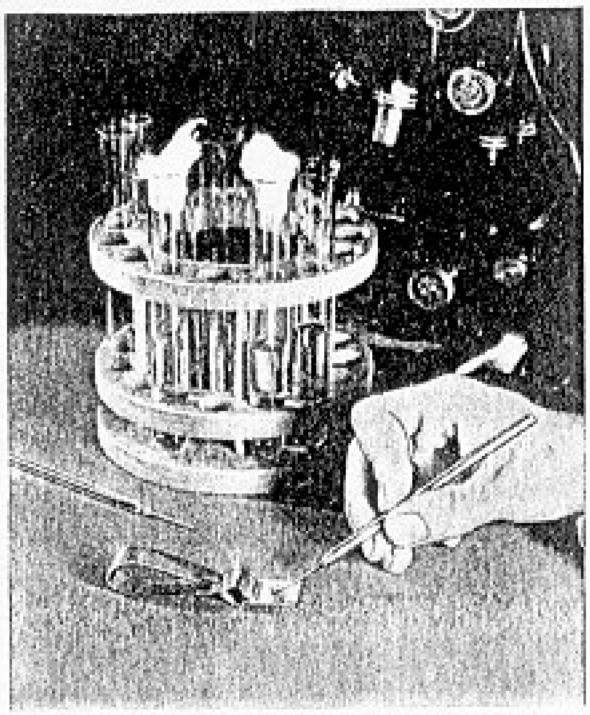
Your bacteria will be either suspended in a liquid, or in the form of a solid. If a solid, convert the material into a liquid suspension by dissolving some of it in distilled water, or in a normal saline solution—six-tenths percent table-salt solution in water. Spread the liquid in a thin, uniform film. If you are using the cover-glass method, place a drop of the preparation on a clean cover glass, bring a second cover glass into contact with it, and immediately draw them apart with a sidewise, sliding motion. With a little practice, you can produce thin, even films. You then have two cover glasses containing the specimen. You can hold the glasses in your fingers, although most workers who use this method prefer to hold them with cover-glass tweezers. When making a preparation directly on the slide, pick up a small drop of the bacteria-laden liquid with a wire loop—platinum usually is used—and transfer it to the center of the slide. With the loop, spread it in a thin film. If the slide is perfectly clean, this will be done easily. Let the film dry by evaporation.

You are now ready to fix the bacteria—to kill them and preserve their form. There are a number of ways of doing this, but only the more common ones will be described. A widely used method is known as flaming. The cover glass or slide is passed rapidly through the tip of a gas or alcohol flame three or four times. Each *(Continued on page 135)*

SOME HANDY ACCESSORIES FOR YOUR MICROSCOPE

Useful in working with bacteria, the three easily made tools illustrated here also will prove to be convenient for many other kinds of amateur microscope study. The wire loop set in a glass handle is ideal for transferring specimens to slides. Tweezers made of spring brass grip cover glasses securely. The simple substage diaphragm increases image contrast





How the specimen liquid is transferred to the slide with a handy glass-handled loop of wire

passage, for a cover glass, should require about a half a second, with intervals of a second or so between. For thicker supports such as slides, allow more time in the flame. The glass should be heated until it is definitely uncomfortable to touch, yet the specimen should not be charred.

A second method of fixing is with flaming alcohol. After the film has dried, support the slide or cover glass horizontally, and place one or two drops of ethyl alcohol on the preparation. Immediately touch a match to the alcohol, and allow the alcohol to burn away completely. When cool, the preparation is ready for staining. Still another fixing method is to drop the alcohol on the preparation, and let it remain for a minute or so, or until it evaporates. It is a good idea to try all three of these fixing processes, for the final appearance of the stained specimen is influenced somewhat by the fixing.

YOU are now ready to stain the bacteria. Gentian violet, methylene blue, or fuchsine, will serve for the amateur just venturing into bacteriology. The preparation and use of these and other stains were described in a previous article of this series (P.S.M., Mar. '37, page 70). Make stock solutions by dissolving each of the dyes to saturation in ninety-five-percent ethyl alcohol.

The preparation is now ready for observation, unless you want to add a cover glass, in which case you simply place a drop of balsam, petroleum jelly, or other medium on the slide and set the cover in place. Use a very thin cover glass if you intend to observe through an oil-immersion lens. Many workers keep their slides on file without cover glasses. The films are durable enough to last for years, although they do collect dust more readily than when covered. For observation through "dry" objectives which are corrected for cover-glass thickness, as are the professional-type instrument lenses, it is advisable to use cover glasses over slides. When oil-immersion lenses are employed, it makes no difference in the optical performance whether a cover glass is present or not. The same probably holds true of most amateur-type microscopes where no correction has been made for cover glasses.

THE foregoing is the general routine of preparing slides of bacteria. However, there are occasions when additional treatment is required, for example, in making slides of buttermilk, sweet milk, and other fat-containing materials. Thus, in the preparation of milk slides, smear milk or cream thinly on a slide and dry by gentle heating. Fat is then removed by immersion of the slide in xylol for about three minutes. Remove the slide and let the xylol evaporate. Then immerse in absolute alcohol for about five minutes, or until the milkiness has disappeared. After staining for two minutes in Loeffler's methylene blue, wash in water and remove stain with alcohol until only a light blue remains. Mount, preferably in glycerine or petroleum jelly.

If you have a microscope well enough corrected to see living bacteria, you will want to try the hanging-drop arrangement. Obtain a hollow-ground slide—one having a depression ground or molded in the center; a clean cover glass, and some petroleum jelly. Smear a thin film of the jelly around the rim of the depression in the slide. Place a tiny drop or two of the liquid containing the bacteria on one side of the cover glass. A wire with a small loop on one end, and held in a convenient handle, is handy for this. Invert the cover glass so that the droplets hang down, and lower it over the hollow in the slide. The jelly seals the edges and prevents evaporation of the drops. Focus carefully on the drops, with the substage diaphragm reduced to a very small diameter, being careful not to break the cover glass by too much downward pressure if using a short-focus objective. In this way you can observe live bacteria from your mouth and other sources.

BACTERIA are divided for convenience of study into three groups, the rod-shaped bacilli, ball-like cocci, and the corkscrewlike spirilla. (Single ones are called bacillus, coccus, and sprillum, respectively.) Each of these groups is subdivided according to various characteristics of its members. Thus, bacteria with tails are called flagellated bacilli, or flagellated spirilla. Groupings are made according to the number and position of the flagella, and according to the way the individuals arrange themselves.

There are several ways of improving the performance of microscopes, particularly the amateur variety, so that they will produce sharper images of such things as stained bacteria. These will be summarized briefly, but detailed directions for altering a particular kind of microscope will not be given because of the variety of microscope designs. The ingenious amateur can easily work out his own problems.

LACK of sharpness in microscope lenses results from the fact that all colors of light are not brought to focus at the same place. This is particularly true of low-cost lenses, for to make the colors behave requires lenses of high correction and consequent high cost. The easiest way to cancel color aberrations is to eliminate some of the colors, leaving one that the lenses focus sharply. This is done simply by placing a color screen or filter somewhere in the light beam. A piece of colored glass, gelatin, cellulose film, or liquid in a glass container, will do. For most microscopes, green or yellow is best. The use of a color filter with stained specimens has the added advantage of increasing their contrast. Thus a red filter used with blue-stained bacteria will make them appear blacker. Because you cancel the effect of some of the light when you use a color filter, it is necessary to increase the intensity of illumination.

Manufacturers of amateur microscopes usually omit substage diaphragms that would enable users to control the diameter of the beam of light reflected from the mirror. With a diaphragm, the beam can be cut down until it increases the contrast of the image and improves the depth of focus. You can improvise a substage diaphragm by fastening a small iris diaphragm, such as one taken from a camera shutter, below the hole in the microscope stage, or by inserting a piece of sheet metal with a hole in it. It generally is not difficult to rig up a simple holder so that metal slides having holes of different diameters can be inserted in turn until the best hole size is found. Still another arrangement is a rotatable disk with openings of varying size spaced around the center.

IMPROVISING a substage condenser is more difficult than either of the two improvements already described. However, you might try inserting a short-focus plano-convex lens, flat side uppermost, beneath the hole in the microscope stage. Bullseye lenses from some types of flash lights will do. Experiment with different spacings between the lens and the slide. If you use both a substage diaphragm and condenser lens, place the diaphragm beneath the lens.

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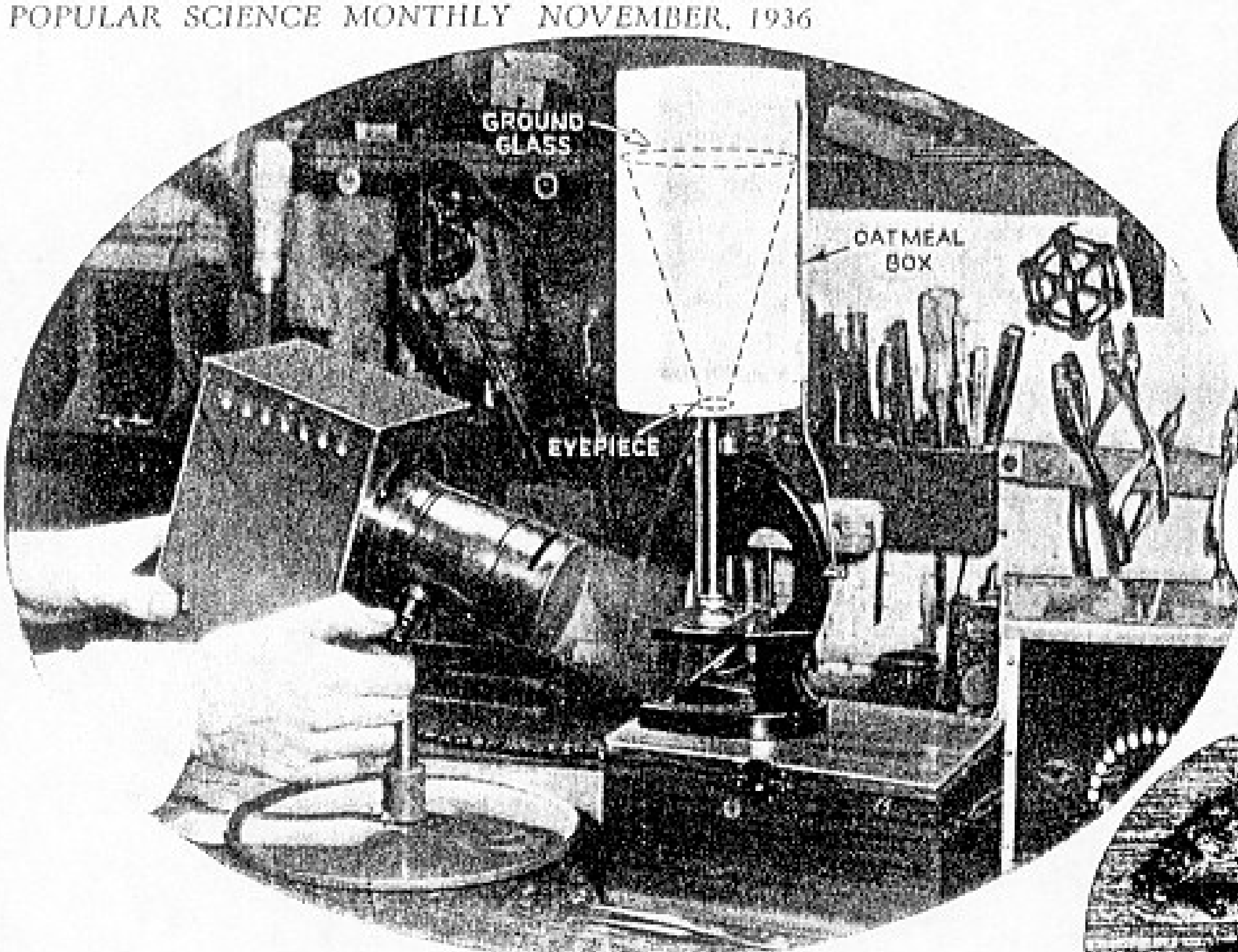
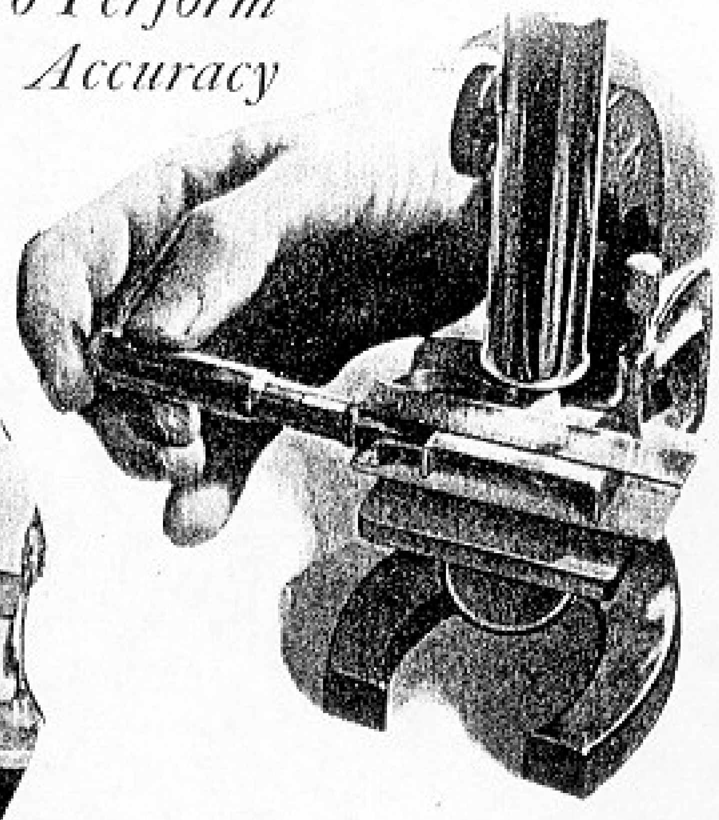
Your MICROSCOPE as a Shop Tool

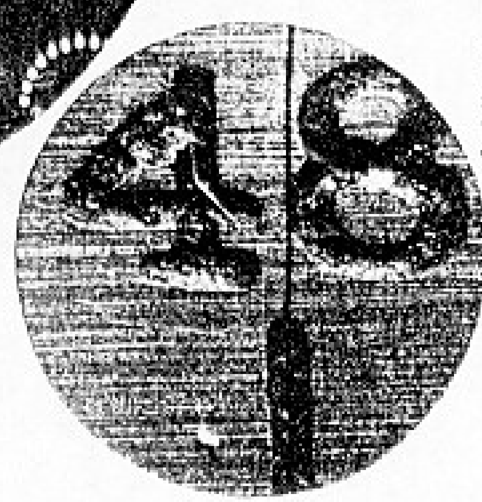
Magic Lenses Enable Home Craftsmen To Perform Many Tasks With More Ease and Greater Accuracy

POPULAR SCIENCE MONTHLY NOVEMBER, 1936



With this simple microprojector set-up, the home craftsman can make examinations of screw threads, model parts, and other objects in the shop





Checking the accuracy of a steel rule with the homemade micrometer stage shown in the drawing below. Left, a division mark as magnified

By Morton C. Walling

PEOPLE who consider the microscrope as a laboratory instrument used only by highly trained scientists and by amateur biologists, would be surprised to know the extent to which it is employed in the machine shop, at the factory bench, in the field, and in connection with the machine tools of countless industrial plants. Much of the present-day precision that is involved in the making of all manner of things, from bolts to battleships, is possible only because the microscope has become a shop tool.

The amateur microscopist frequently is also the owner of a home workshop; or he works in a garage, machine shop, or other place where the magnifying power of glass lenses might have a magic effect, and enable him to do better work than he possibly could turn out with the unaided eye.

A compound microscope of the type used by amateurs can be put to many uses in the workshop without altering it in any way. Magnifications generally required seldom exceed 100 diameters. The jobs such a microscope will do include the identifying of wood, examining of metal surfaces to see how well they are polished, identifying metals by their crystalline structure, examining minute cracks or fractures in metal, checking the cutting edges of tools, and examining paint and lacquer finishes on wood and metal.

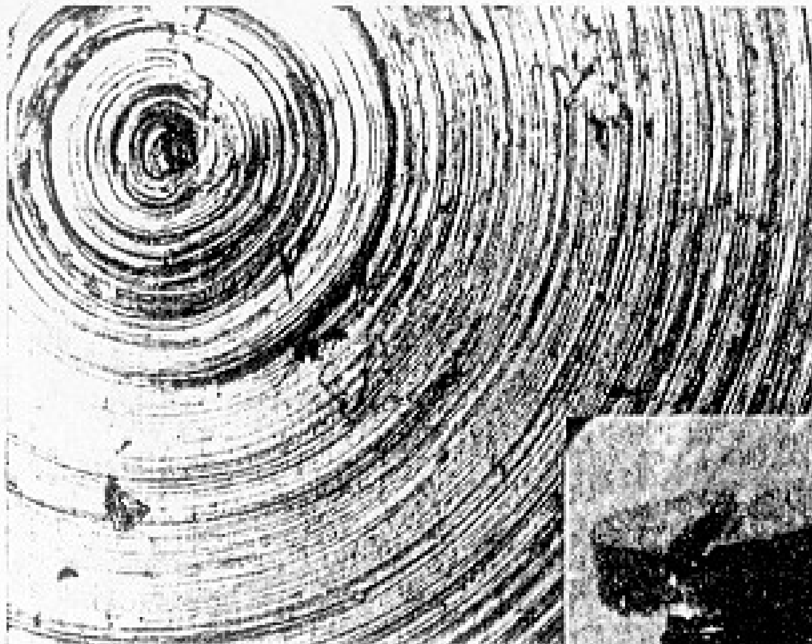
For most of this work you will need, in addition to the microscope, some glass slides, cover glasses, balsam, a sharp cutting tool such as a safety-razor blade equipped with a handle, and a source of illumination that can be adjusted for throwing light either on the substage mirror or on top of the object being examined.

The identification of wood is something that the craftsman who works in this material, particularly if he employs the rare imported woods, must be able to do. There is no more certain way of making such identifications than by means of a microscope.

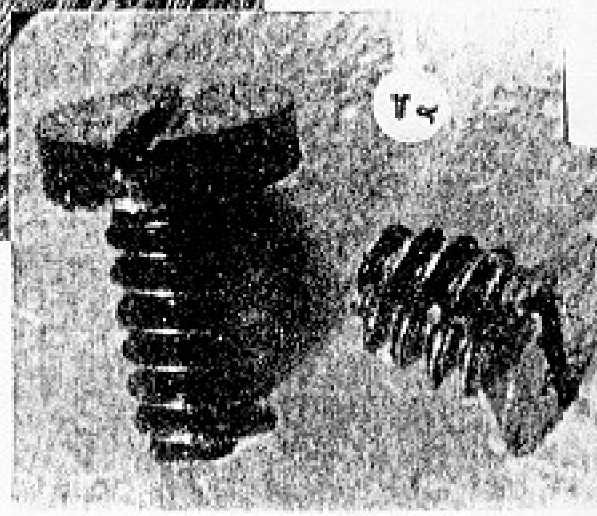
In nearly all cases, an examination of the cross-section appearance of the wood will suffice. This shows the structure and arrangement of the cells making up the wood. Sometimes it is helpful to examine thin, longitudinal sections of wood, so that the sides of the cells instead of their cut ends are seen.

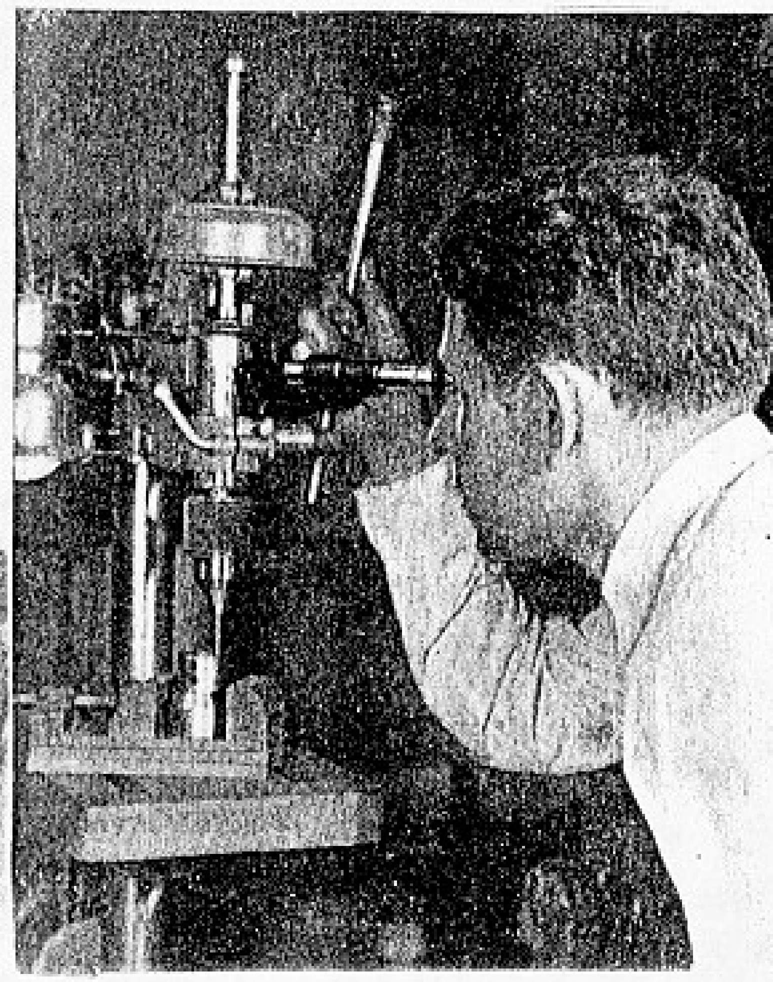
When you look at a thin cross section of wood, you see a series of curved layers formed by the annual growth of the tree, or, if the specimen is a small, woody stem, concentric rings.

In addition, you will see radial lines of cells extending more or less perpendicularly to the rings. These are the medullary rays. Then there may be other distinguishing details, such as the resin ducts in white pine and the extremely large cells scat-

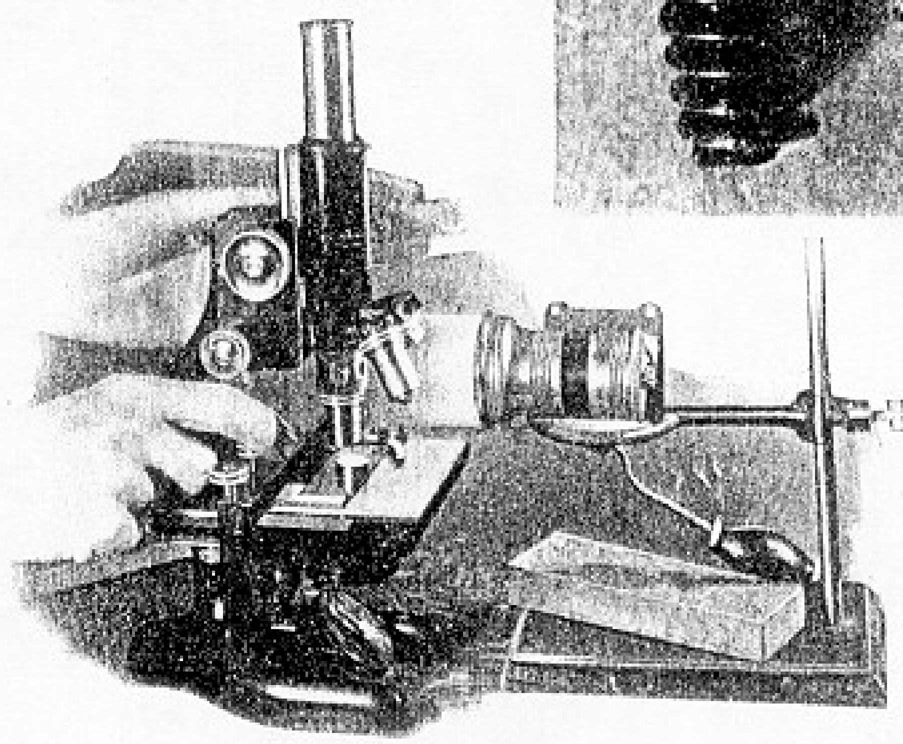


Lathe-tool marks on the end of a turned metal shaft, as seen through the microscope. Below are two tiny screws from a watch, (shown actual size in small circle) magnified for an examination of their threads. The larger of the two is 0.072 inches long



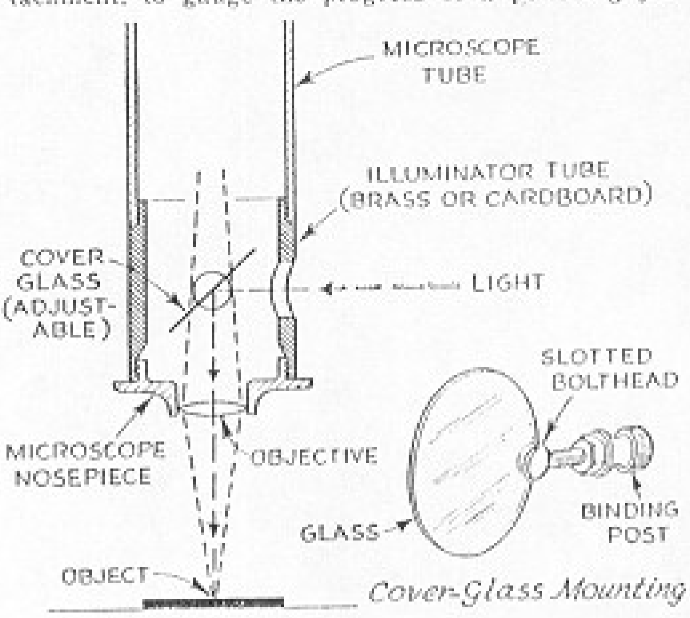


Using a small microscope in precision drilling. It is focused on a scale that moves with the drill bit



EXAMINING METAL WITH A MICROSCOPE

Surface markings on a brass button being inspected by means of a commercial vertical-illuminator attachment, to gauge the progress of a polishing job



HOW TO MAKE A VERTICAL ILLUMINATOR

If your microscope has an objective lens that can be unscrewed from the tube, you can rig up this vertical illuminator for examining various opaque objects

tered through walnut.

The arrangement of cells in a given specimen of wood produces a pattern that is characteristic of that wood. Thus, if you are familiar with the appearance of a piece of walnut under the microscope, you always can tell with certainty whether a sample of wood is walnut or not.

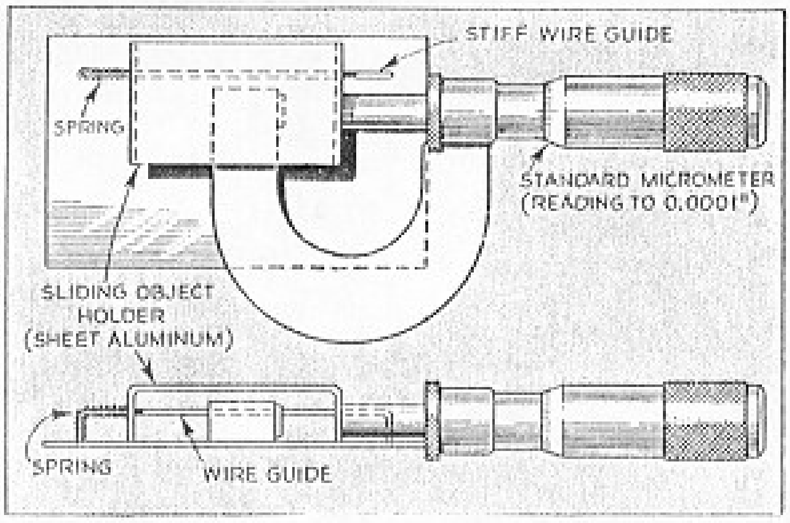
You can easily collect samples of various kinds of cabinet woods, including such well-known varieties as walnut, mahogany, and maple, as well as a great many of the rarer woods. From such samples you can make microscope slides which, when properly labeled and filed away, form a reliable reference "library" that can be used for identifying unknown woods at any time in the future.

The making of such a reference slide is a simple operation. Select a small block of seasoned wood that has not been stained, painted, or otherwise treated, and slice a number of very thin pieces from one end. A keen-edged razor blade can be used; and you can make satisfactory slices free-hand. Examine several of the tiny chips, and select the ones that show the grain structure most plainly. Try to include sections of three or four annual rings in each piece that you select for mounting.

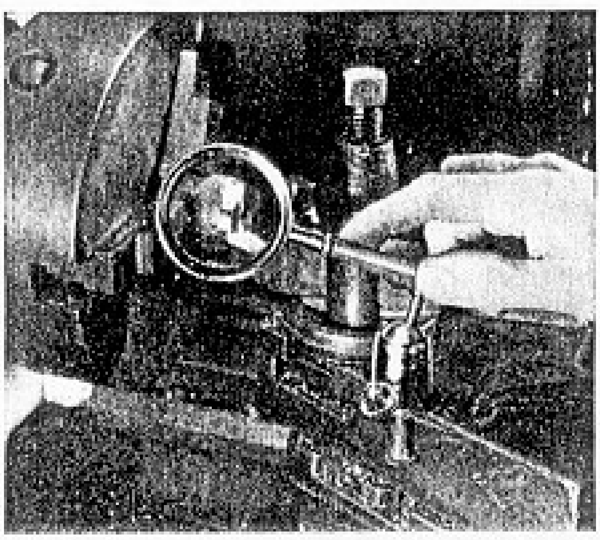
As the wood already is dried, you can mount the slices immediately. To do this, drop a little Canada balsam in the middle of a clean glass slide, dip the wood specimen in xylol, and with tweezers lay it on top of the drop of balsam. Gently press the wood down into the balsam, until it is covered completely. The object is to immerse the wood without trapping air in its cells. Finally, lay the cover glass over the balsam, and set the slide aside to dry. Of course, if you desire, you can stain the wood with methylene blue or other dye, but most woods can be mounted without staining. Examine wood specimens by transmitted light, at magnifications of twenty to 100 diameters.

Frequently, the craftsman who is working with metal desires to know how well a polishing or grinding operation is being carried out. His unaided eyes may tell him; and again they may leave much room for doubt. But with a small microscope, he need never be uncertain. At fifty to 100 diameters, the surface marks on a piece of metal stand out like furrows in a plowed field. What appears to the unaided eye as a brilliant polish will be seen as a collection of irregular grooves and ridges. By comparing the depth and size of these markings, the degree of polish can be determined. In a similar way, bearing surfaces can be inspected, and bits of embedded metal or pits caused by corrosion can be seen. Metal objects can be examined for indications of rusting or other corrosion, and a hundred and one other useful observations can be made.

Since metal is opaque to light rays, it must be illuminated from above. Professional microscopes are equipped with ver-



tical illuminators which send light rays down through the objective lens, to be reflected through the same lens by the metal surface. Although you can construct an effective vertical illuminator by mounting a cover glass or bit of mirror between the objective



A hand magnifying lens attached to a lathe carriage with a ball-and-socket tripod joint

and eyepiece and arranging a hole in the side of the mounting for light to enter, most shop inspections can be made with light coming at an angle, from a source above and to one side of the stage. A small automobile spotlight operated by a suitable transformer or battery makes a satisfactory illuminator. It is placed so that the brightest spot is focused on the metal specimen, at a point directly below the objective.

One of the drawings shows the construction of a vertical illuminator for use with a microscope that has an objective lens that can be unscrewed from the microscope tube.

Metals resemble woods in that they have characteristic structures. These crystalline structures are used in metallurgical laboratories for identifying unknown alloys, for determining the effect of heat treatments, and for learning other inner secrets of metals. Although the home craftsman usually does not find it necessary to go into the crystalline structure of alloy steels and other metals, the amateur microscopist who is also a metal worker may find it interesting to know how specimens are prepared for microscopic examination.

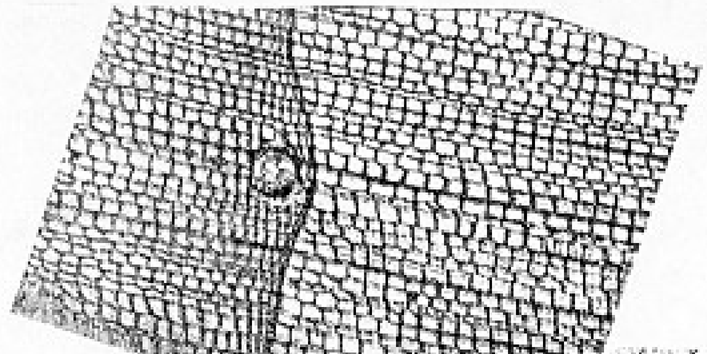
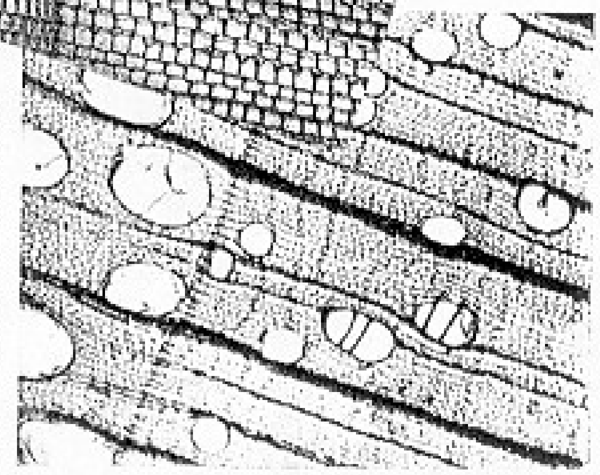
FIRST, it is necessary to give the metal to be examined a very high polish. This can be done by grinding the specimen flat with a fine-grained wheel, honing it on first a rough and then a fine-grained razor hone, polishing it with successively fine grades of abrasive powder, and ending up with optical rouge or some other polishing agent that produces scratches smaller in diameter than the length of a light wave. Polishing powders are held in "laps" made by tacking pieces of cloth to blocks of wood, moistening the cloth with water, and sprinkling it with the abrasive powder. A different lap is used for each grade.

After a polish is produced, which reveals no deep or wide grooves when examined by the microscope, the metal is ready for etching. There are a great many etching agents in use. These include a mixture of ammonia water and hydrogen peroxide, for brass; a five-percent solution of silver nitrate in water, for lead-tin alloys; a two-percent solution of nitric acid, for cast iron; concentrated nitric acid and ammonium persulphate, for steel; picric acid in methanol, for steel; equal parts of hydrochloric acid and water, for revealing fractures in steel; and various concentrations of nitric acid in water, for steel.

After the etching solution has acted, wash the specimen in water, and, if an iron alloy, dry it as rapidly as possible, in order to avoid oxidation. Examine it with the aid of a vertical illuminator, if you have one. Otherwise, arrange the light so that it strikes the specimen as nearly as possible at right angles. Minute fractures
in steel, copper, and various other metals can be examined with the microscope at moderate powers. Usually, such tiny cracks in steel can be revealed by etching for ten to twenty minutes in a half-and-half solution of hydrochloric acid and water.

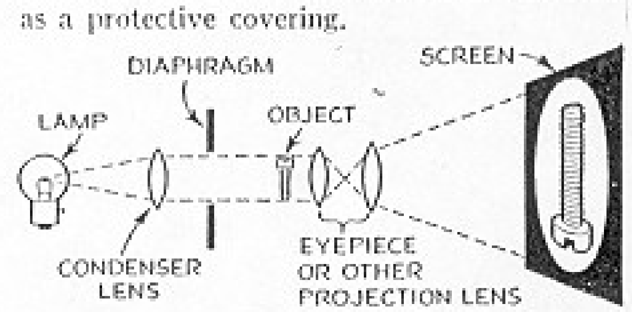
The edges of such tools as lathe bits, carving chisels, metal engraving tools, tiny drills, razor blades, and a host of other cutting instruments can be examined easily with the aid of a microscope. Usually, a magnification of ten to fifty diameters is adequate. The tools can be illuminated by light coming from behind them, so that their edges are seen in silhouette; or they can be illuminated from above or at an angle, so that surface details near the cutting edge are seen. It is best to use both methods when possible.

In the laboratories of automobile manufacturers and other concerns using cellulose lacquers or paints, microscopic examinations are made to determine the wear and weathering properties of the finishing materials, and to check their uniformity. Examination of a painted surface after it has been

Samples of wood under the microscope. Above, a cross section of white pine, showing a resin duct and the division between fall and spring growths. Right, walnut; dark lines are medullary rays

in use for a time may reveal surprising facts about its condition. It might look perfectly smooth and intact to the eye, yet be shown by the microscope to be broken up by a network of fine cracks that render it worthless as a protective covering.



Your microscope can be used as a projector by setting the object in the position shown here

Another important industrial use for microscopes is in making precision measurements. Professional-type microscopes like those found in a well-equipped biology laboratory can be provided with special micrometer eyepieces with which accurate measurements of diameters and lengths can be made.

The amateur microscope can be converted into a crude but effective measuring device for small objects by mounting on its stage a machinist's micrometer in such a way that turning the micrometer screw moves the object laterally. One possible way of doing this is illustrated. The object is supported by a platform of sheet metal that moves sidewise against the action of the micrometer. The amount of movement is read on the micrometer scale.

IT IS necessary to equip the microscope eyepiece with a marker that is set at the point on the object from which measurement is to be made. This marker can be a bristle from a camel's-hair brush, cemented with a drop of balsam at a point in the eyepiece where a sharp image of it will be seen; or it can be a strand of spider web. This point usually is in the plane of the diaphragm in the eyepiece.

Suppose you are going to measure the distance between two holes in a piece of metal. Lay the piece on the movable stage platform and move it until the center of one hole is directly beneath the cross hair in the eyepiece. Note the micrometer reading. Then turn the micrometer screw to move the object until the other hole is beneath the hair. Make

another reading. The difference between it and the first indicates the distance between the holes, in

thousandths or ten-thousandths of an inch.

Recently there has appeared on the market a micrometer, made of cast metal, that retails for twenty-five cents or less. It can be converted into a stage measuring device of fair accuracy, although not as durable or of as great range as a larger and more costly instrument such as machinists use.

A MICROSCOPE with a cross-hair eyepiece can be used as a super-eye for reading scales divided into small fractions of an inch or millimeter. Magnifications of moderate degree, say ten to twenty diameters, are employed. The field should be large enough to enable differences in engraved lines to be seen. The microscope is mounted so that it can be focused on a scale that is attached to the movable part of a machine, or the scale can be fixed and the microscope movable. Thus the microscope might be fastened to a lathe bed and focused on a scale attached to a chuck mounted on the tailstock spindle, to measure the depth of a hole being bored in work held on the faceplate; or the microscope could be mounted on a drill press and focused on a scale attached to the spindle housing, for precision drilling. Another application is to mount the microscope on a lathe carriage and focus it on a scale fastened to the tailstock or other stationary part, for precision turning when there is no calibrated carriage feed on the lathe.

Even the microprojector has invaded the workshop. In hundreds of industrial plants, such instruments are used to check the contours of gear teeth and screw threads, measure the size and shape of small machine parts, and are being used daily to do a thousand and one other things.

Such instruments, called contour projectors, consist of a microscope or projection lens, a source of illumination, a screen, and an object holder. The object to be projected can be mounted between the lamp and the microscope lens, just as a standard slide is placed. A shadow image of it is thrown on the screen, where a chart can be placed to indicate how well the object conforms to standard specifications.

A simple vertical illuminator is provided for use with such instruments for throwing light vertically on the surface of polished gears or other metal parts. This illuminator consists of a sheet of clear glass placed at an angle of forty-five degrees to the surface of the object, and a light source mounted so that it projects a beam against the glass, which in turn reflects it to the object.

THE AMATEUR microscopist can rig up a useful microprojector for throwing images of screw threads, gears, tool edges, saw teeth, and other small objects on a screen where they can be inspected in magnified form. The model maker will find such a device useful for producing miniature parts that are exact scale models of larger parts. The part is drawn, in enlarged form, on a sheet of paper, and used as a pattern to check the shape of a smaller model of the part, whose image is projected on the drawing.

The projector can take a variety of forms. A simple arrangement is to mount a light source, preferably a concentrated-filament lamp such as an automobile headlamp operated by a toy transformer, in such a way that its beam illuminates an object placed on the microscope stage. The lowest power of the microscope usually is sufficient. The beam can be directed against a ground-glass screen supported above the eyepiece, against a sheet of white paper, or against a mirror which reflects it on a sheet of white cardboard or paper.

Popular Mechanics October, 1904

Knots and Miles.

Knots	Miles	Knots	Miles	Knots	Miles	Knots	Miles	Knots	Miles
1.00	1.1515	6.00	6.9091	11.00	12.6667	16.00	18.4242	21.00	24.1818
1.25	1.4394	6.25	7.1970	11.25	12.9545	16.25	18.7121	21.25	24.4697
1.50	1.7273	6.50	7.4848	11.50	13.2424	16.50	19.0000	21.50	24.7576
1.75	2.0152	6.75	7.7727	11.75	13.5303	16.75	19.2879	21.75	25.0455
2.00	2.3030	7.00	8.0606	12.00	13.8182	17.00	19.5758	22.00	25.3333
2.25	2.5909	7.25	8.3485	12.25	14.1061	17.25	19.8636	22.25	25.6212
2.50	2.8788	7.50	8.6364	12.50	14.3939	17.50	20.1515	22.50	25.9091
2.75	3.1667	7.75	8.9242	12.75	14.6818	17.75	20.4394	22.75	26.1970
3.00	3.4545	8.00	9.2121	13.00	14.9697	18.00	20.7273	23.00	26.4848
3.25	3.7424	8.25	9.5000	13.25	15.2576	18.25	21.0152	23.25	26.7727
3.50	4.0303	8.50	9.7879	13.50	15.5455	18.50	21.3030	23.50	27.0606
3.75	4.3182	8.75	10.0758	13.75	15.8333	18.75	21.5909	23.75	27.3485
4.00	4.6061	9.00	10.3636	14.00	16.1212	19.00	21.8788	24.00	27.6364
4.25	4.8939	9.25	10.6515	14.25	16.4091	19.25	22.1667	24.25	27.9242
4.50	5.1818	9.50	10.9394	14.50	16.6970	19.50	22.4545	24.50	28.2121
4.75	5.4697	9.75	11.2273	14.75	16.9848	19.75	22.7424	24.75	28.5000
5.00	5.7576	10.00	11.5152	15.00	17.2727	20.00	23.0303	25.00	28.7879
5.25	6.0455	10.25	11.8030	15.25	17.5606	20.25	23.3182	25.25	29.0758
5.50	6.3333	10.50	12.0909	15.50	17.8485	20.50	23.6061	25.50	29.3636
5.75	6.6212	10.75	12.3788	15.75	18.1364	20.75	23.8939	25.75	29.6515

Table Showing Knots Reduced to Miles.

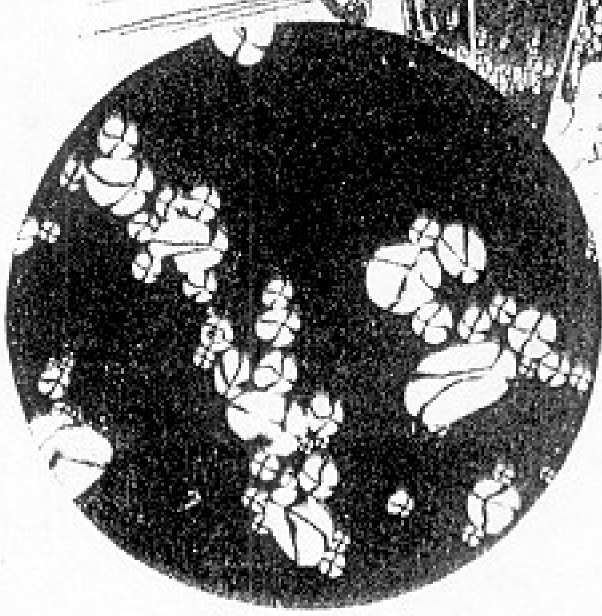
A nautical mile or knot is 6,080.27 feet. For the benefit of those who are interested in the speed of sailing craft of all kinds, the Motor Boat has compiled a table of ready reference in which the various number of knots are reduced to land miles. The table will save a lot of figuring which would otherwise be necessary.

ART DESIGNING with Your MICROSCOPE

This Article Tells You How You Can Capture The Elusive Beauty of Tiny Objects Seen Through Your Magic Lenses, Employing Them As Models for Novel, Striking Decorations

By MORTON C. WALLING

POPULAR SCIENCE MONTHLY JULY, 1937



PATTERNS FOR DRESS GOODS

Designs printed on dress goods often are inspired by microscopic objects such as the potato-starch grains shown at left as seen under polarized light

IN YOUR explorations of the wonders of the microscopic world, you must have paused often to marvel at the sheer beauty of some pattern disclosed by your magic lenses. It may have been the symmetrical cell structure in a cross section of a woody plant stem, the fantastic outlines of some tiny animal, or the geometric perfection of crystals. Have you ever thought that these miniature art works of nature might be magnified to serve as decorations, lending their beauty to practical objects that we use?

As a matter of fact, artists who design such things as printed dress goods and wall paper frequently are influenced by the beautiful patterns that can be seen only with the microscope. Browse through the dry-goods section of a department store, and you probably will come across some percale or other printed material that is covered with modified diatoms. The wall-paper department will make you suspect that some of the artists have been looking at crystal patterns or other objects through a microscope.

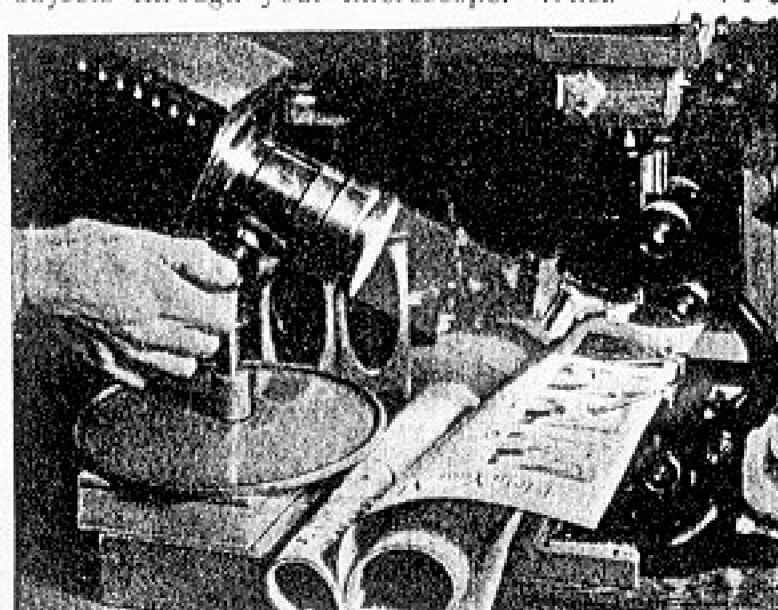
The microscope can serve as a designer in various ways. If you have occasion to work out an unusual pattern for a wall decoration, book cover, table top, or anything else upon which you want to leave the stamp of originality, it will pay you to spend a little time looking at random objects through your microscope. When you discover a promising subject, it is a simple matter to make a drawing of it on a piece of paper. From this basic pattern, you can develop the required design, just as you can employ a drawing of a tulip as the basis for a decorative motif.

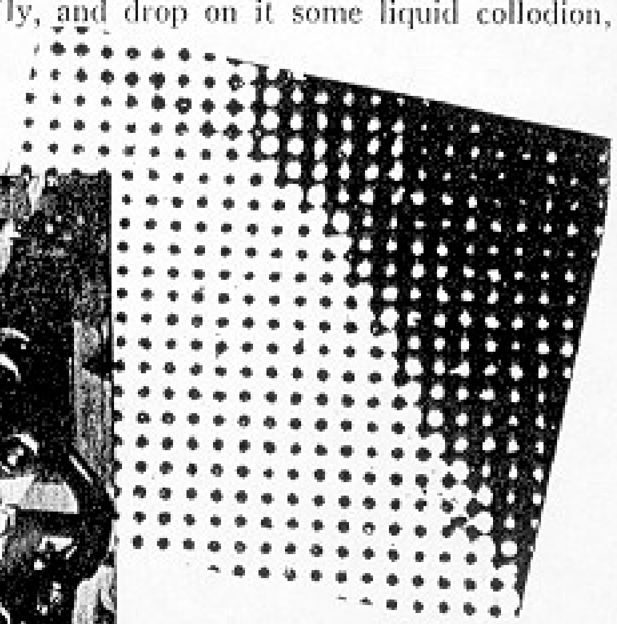
When the microscope is coupled with a camera, the possibilities of making use of its designing abilities become even greater. There are hundreds of ways in which you might employ photomicrographs in decoration.

Suppose, for instance, that you have the job of finding an unusual background design for use in a booklet, a party invitation, or some other place where the design will form a foundation for lettering and pictures. Get out your collection of slides and examine them for possibilities.

For instance, consider a group of slides showing cross sections of woods—white pine, walnut, mahogany, oak. Enlarged to a hundred diameters, the network of cells and ducts forms a pattern as beautiful as that of fine lace. The same holds true of slides containing groups of hairs and textile fibers in cross section. Most people probably would not recognize these things if they saw them in the form of photographs or reproductions, but the patterns are interesting enough to enable them to stand out on their own merits.

Have you ever been fascinated with those patterns that seem to change their shape or perspective while you look at them? The microscope can produce them, too. Obtain an oyster shell or some other shell that has a mother-of-pearl lining. Wash the pearly surface (nacre) thoroughly, and drop on it some liquid collodion,





Make a photomicrograph of one of the photographs on this page, using the simple set-up pictured at the left, and you will get an arrangement of dots suitable for decoration

which you can get at the drug store; or you can dissolve some celluloid in acetone to produce a similar material. Spread the collodion out in a thin layer and let it dry. Then strip the film carefully from the shell and mount it on a slide.

When you examine it with your microscope, you will find that the collodion has received the impression of the tiny ridges or folds that produce the beautiful iridescence of pearl. Make a photomicrograph of the film, adjusting the light carefully to bring out the folds. Gaze at the print steadily and, if the lighting is correct, you will be surprised to see the pattern suddenly flop into reverse. In a similar way you can make a reversible picture of the outer surfaces of mussel and other shells that are made up of little hexagonal blocks of limestone.

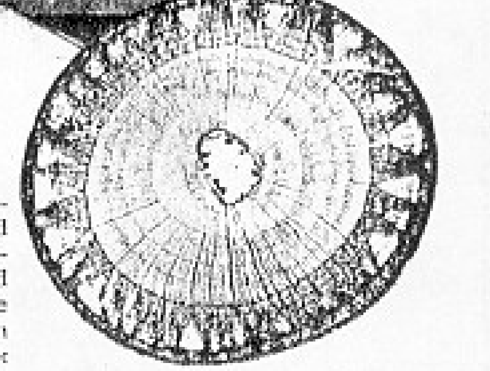
A design suitable for many background uses consists merely of a network of lines, something like chicken wire. Again, the sea shell can help you. Select a mussel or similar shell, and break a piece from it. Soak this in weak muriatic (hydrochloric) acid until bubbles cease to rise from it. This dissolves out the lime deposit, leaving the membranous partitions between cells. Properly focused by the microscope, this network forms an attractive pattern that can be shown in a photomicrograph.

If you do not wish to use the picture as it is, trace over the principal lines with India ink, and then bleach out the image. A suitable bleach consists of a solution made by diluting tincture of iodine with about six parts water. Soak the print in it until the image has turned uniformly brown, or disappeared entirely. Then remove the iodine and the remaining traces of the image by immersing the print in ordinary hypo fixing bath. Wash and dry.

Perhaps your decorative problem consists of working out an attractive and unusual border for a picture, for a band across the cover of a book or folder. A photomicrograph of one of the algæ, such as Spirogyra, may serve your purpose. The orderly row of cells, each almost exactly like the other, produces the desired border effect.

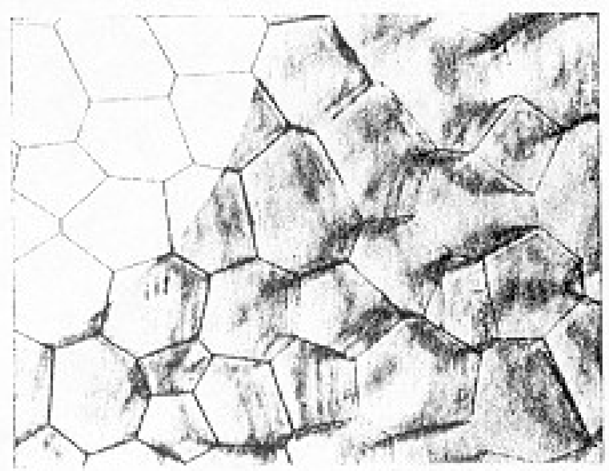
Another way of developing an interesting border is to arrange a series of images. Thus you can make an attractive design by printing or drawing a number of pictures of a diatom, and arranging them side by side. Likewise, the images can be arranged to form a star-shaped pattern, or almost any other shape you desire.

Diatoms alone offer almost endless possibilities. Designers have used them as inspiration for a great variety of patterns. Many diatoms are in themselves so beautiful in form that no human artist can improve upon them. Makers of diatom slides sometimes arrange the tiny bits of glasslike silica in attractive patterns. Photomicrographs of such pattern arrangements



MOTHER NATURE AS DESIGNER

A cross section of basswood stem, photographed under the microscope, enlarged, and traced in red ink, makes an attractive cover design for use on a notebook or scrapbook



A pattern being developed by tracing a photomicrograph that shows membranous partitions between limestone blocks in a sea shell

can be used in decoration. Pollen grains, insect eggs, and other small objects whose shapes make them beautiful can be used in "spotty" decorative schemes such as those employed for wall paper, dress goods, or book covers.

Speaking of book covers, here is an idea that you might find useful for such things as notebooks, scrapbooks, and diaries: You are going to make, for instance, a botany notebook, and want an appropriate cover. What could be more logical than a photomicrograph of some botanical subject? Perhaps the cross section of a flower stem or a leafy bud, or the membrane from a bean cotyledon stained with Loeffler's methylene blue, would be suitable.

Whatever the picture you choose, print it on a dull-surfaced paper. There is available a type of photographic paper intended for use in printing maps, pages for salesmen's catalogs, and so forth. It is a thin paper with a mat surface coating that will not break easily when bent. This is ideal for cover work. After the print has been washed and dried, glue it securely to the cover, which probably will be a sheet of stiff cardboard. When the glue has dried, give the surface of the photograph a coat or two of clear varnish or lacquer, to protect it. Any lettering should be added before the varnish is applied. Likewise, if you desire to color the photographic design with water or oil pigments, do so before the final varnishing.

Instead of covering the entire surface of the backing material with a photograph or group of them, you can apply a single print, in the form of a circle, rectangle, or other shape, and varnish it for protection. Use a good grade of glue for such work. One of the most permanent is stainless casein glue, which is waterproof after it dries. Rubber cement can be used for temporary work, but is not recommended when the job is expected to last several years.

THE present popularity of photographic murals for decoration suggests the idea that photomicrographs might be employed in some instances. Thus, the walls of a biological laboratory could be papered or paneled with photomicrographs of biological subjects, which, besides being decorative, would be instructive as well. Such photomurals are simply greatly enlarged photographs hung like wall paper. They can be protected by a transparent varnish or lacquer coat when necessary. Frequently the murals are arranged in panels, rather than as a cover for the entire wall.

And so, in these and a thousand other ways, photomicrographs and drawings of microscopic objects can serve the world of art as well as that of science. The applications of such designs are limited only by the imagination and ingenuity of the people using them.

In general, microscopic objects that are, in themselves, interesting in form make the best

designs. The plant world offers some of the most promising and most easily prepared material. Simply by slicing thin sections from a leaf, stem, leaf bud, or flower bud, you can obtain great beauty of form. Although sections cut with a precision microtome are the best, you can do very well with a razor blade and a wooden chopping block, or a simple hand microtome. Soft stems frequently are easier to cut if braced by inserting them between two grooved pieces of potato, carrot, cork, or other firm but easily sliced material.

FOR modernistic patterns, the crystal world offers many suggestions. Dissolve some Epsom salts, copper sulphate, borax, or almost any other crystalline substance in warm water, place a drop of it in the middle of a clean slide, set it aside to dry, and you have a beautiful work of art. If you are seeking suggestions for color harmony and contrast, examine the crystalline pattern by polarized light, as described in a recent installment of this series (P.S.M., Dec. '36, p. 52). The only difficulty you will have is in reproducing the marvelous colors with ordinary pigments.

Permanent capture of such colors can be made only with the aid of color photography. Not long ago there was introduced to the photographic world a new film that reproduces color with amazing faithfulness. It is excellent for making natural-color records of colored microscopic objects. The single colored transparency obtainable with each exposure can be used for making a duplicate negative from which any number of black-and-white copies can be printed. Thus the original color picture can preserve also the form, and make it available for photographic reproduction in unlimited quantity.

In the sands of the sea you can find objects whose beauty suggests their use as artists' models. Seagoing diatoms are, of course, among the most beautiful. Near the surface of the sea in warm climates you will find radiolarians, whose basketlike skeletons, seemingly spun from the finest crystal, ought to provide inspiration for designers of glassware and jewelry. Among the grains of sand found in sponges you may discover tiny foraminifer shells—microscopic sea shells often of great beauty.

Some of the microscopic shells exhibit a curve that is, according to art authorities, among the most beautiful forms in nature. It is known by various names, such as the "curve of growth" and the "Greek rhythmic curve." The boundary line between the spiral layers of a chambered nautilus, or even of a common snail shell, is in the form of this magic curve. The animal inhabiting the shell produces such a curve when it increases the size of the shell without changing its shape. The rhythmic curve is employed widely in design and composition. You will see it in the decorations on furniture, fabrics, and an almost endless number of other articles; and you can detect it in the composition of paintings and photographs.

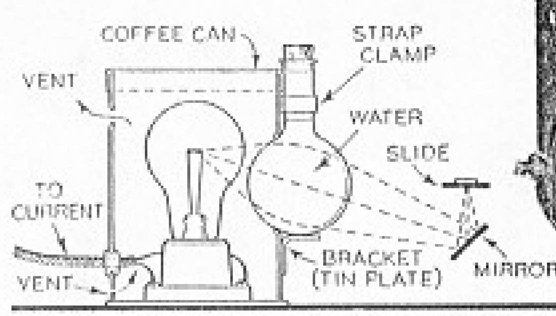
ALMOST every object upon which you turn your microscope's inquiring eye might be used as a pattern for a design—the scales on insect wings, the mosaic of lenses in the eye of the bee or fly, vase-shaped spore pods of fungi, the snail's tongue, which you can obtain by boiling the entire snail in lye solution—these and a thousand and one other things can serve as your starting point for something new and striking in the field of decorative design.

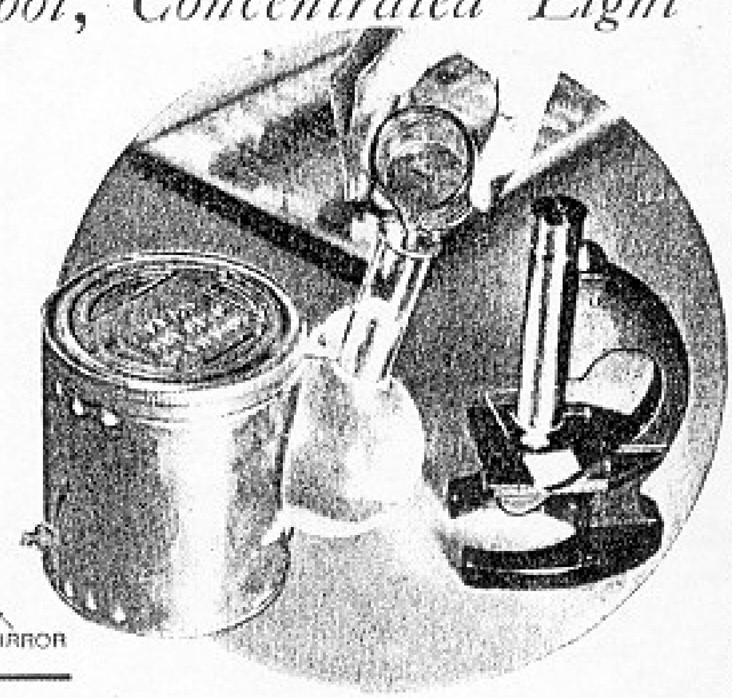
Lamp Made from Tin Can Gives Cool, Concentrated Light

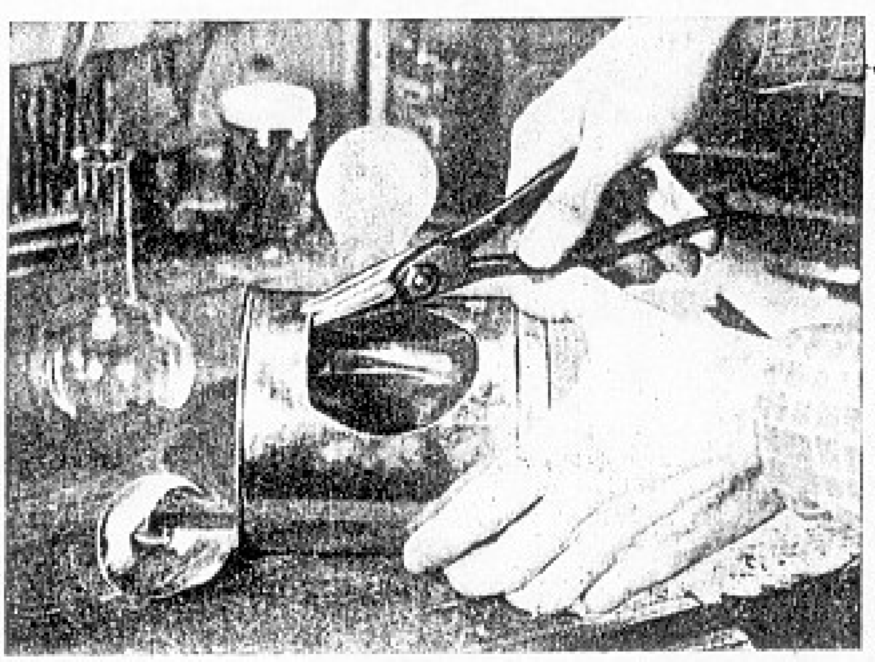
WITH the simple tin-can lamp illustrated, you can give your microscope slides illumination that is concentrated in a relatively small spot, and from which the heat rays have been removed.

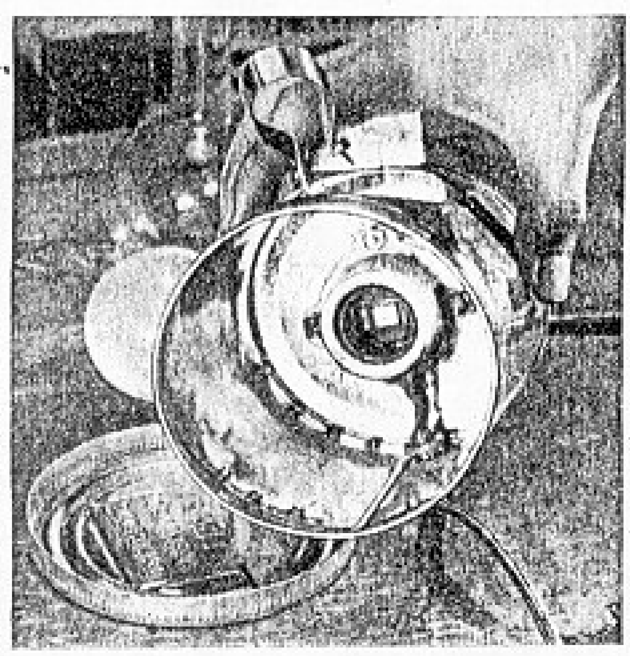
Mount a porcelain lamp socket in the bottom of an empty coffee can, running the wires through a hole. In one side of the can, cut a hole just large enough to accommodate the bulbous part of a round-bottom laboratory flask of 200 or 250-cubic-centimeter size, placing the center of the hole a little lower than the filament of a twenty-five or forty-watt lamp screwed into the socket. A few holes punched in the side of the can opposite the flask opening will serve as ventilators.

When the lamp is to be used, fill the flask with water and cork it with a wad of cotton or a stopper with a hole in it to permit expansion of the liquid. Copper sulphate added to the water will make the illumination more like daylight, and the flask also can be used for holding liquid filters.









HOW THE TIN-CAN LAMP IS BUILT

A glass flask, mounted in an opening in the lamp housing and filled with water or a colored solution, cools and concentrates the light coming from the bulb set inside. The photographs show how the coffee can is cut, the lamp socket mounted in it, and the flask being filled with liquid. The drawing illustrates the set-up of the outfit and the way it operates

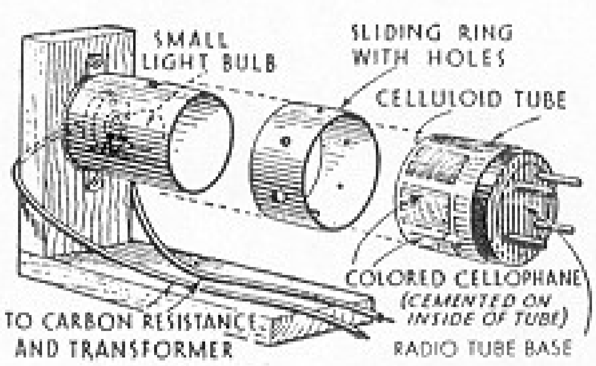
Simple Microscope Lamp Gives Wide Range of Light

By H. J. SEXTON

Popular Science Monthly — April 1934

AN EFFECTIVE microscope lamp, which has an adjustment for various light intensities and a choice of numerous light apertures and several color filters, can be built from the base of a burned-out radio tube, a metal socket for the tube, an adjustable carbon resistance, a 10-volt bell-ringing transformer, a 6.3-volt radio panel-lighting bulb, a screw base for this lamp, a piece of transparent celluloid, small strips of variously colored cellophane, a piece of 1/16-in. strip brass, a 9-in. piece of ¼ by 2 in. hardwood or bakelite, some insulated electric wire, and a socket plug. About half a dozen small brass bolts and nuts such as are used for radio work are also required.

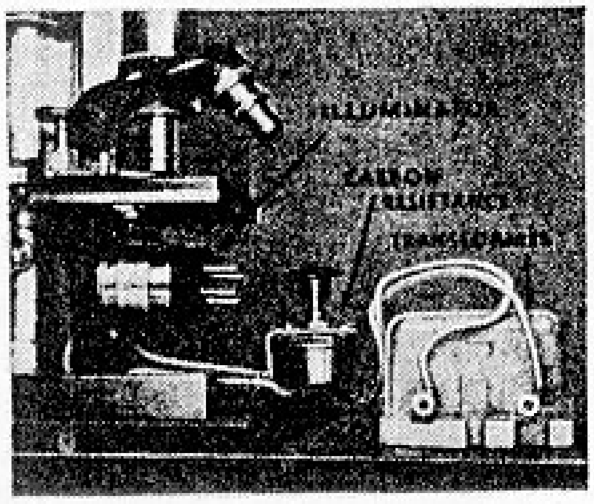
The piece of hardwood is cut into two parts. These are fastened together with three screws at right angles to form a support for the lamp. The support, when assembled, must be of such dimensions that it will just fit under the microscope stage. To the upright part is affixed the radio-tube socket, the screw base for the small lighting bulb, and the necessary insulated wiring for the lighting circuit. The adjustable carbon resistance is fastened to the base by means of a brass strip, and connected in series in the lighting circuit. From the strip of 1/16-in. brass is formed a ring to fit the metal radio-tube socket on the outside. This ring is drilled in a line around its periphery with various holes from 1/64 in. or smaller to 1/32 in. or larger in diameter. The socket itself is drilled at its highest point, immediately underneath the opening in the microscope stage, with a ⅛-in. drill. The ring



The parts separated to show how the size of aperture and color of light are controlled

is now placed over the socket. By turning it, various-sized openings for the light can be brought in line with the ⅛-in. hole.

The color filter, which revolves inside the bulb, is made from the base of a radio tube, a piece of transparent celluloid, and several variously colored strips of cellophane. The glass of the radio tube is broken, and the bulb base sawn off about ⅜ in. from the prong end. A cylinder is made of the transparent celluloid and cemented to the sawn-off tube base. Narrow strips of the colored cellophane are cemented with Canada balsam lengthwise inside this transparent celluloid cylinder. One section, however, is left uncovered to provide a white light. The cylindrical color filter, when assembled, must fit inside the metal radio socket. The projecting prongs form a handle for revolving the cylinder, bringing each of the color filters in succession between the light bulb and the opening in the outside ring. The lighting wires are now connected to the 10-volt side of the bell-ringing transformer, and the 110-



This microscope lamp is easily adjusted for light intensity, color, and size of aperture

volt side of the transformer is connected to the house lighting circuit by means of a socket plug.

Adjustment of the light intensity is obtained by operating the carbon rheostat. Adjustment of the light aperture (or iris) is obtained by revolving the brass ring on the metal radio-tube socket, and either a colored light or white light is obtained by revolving the cylindrical color-filter holder inside the socket.

It will be observed that the voltage on the output side of the bell-ringing transformer, 10 volts, is greater than the small incandescent bulb capacity, 6.3 volts. This is necessary to bring the bulb to full brilliance, but the circuit is always used with some resistance in. A flashlight bulb of from 2.5 to 4.5 volts may be used when connected to a dry or storage battery, and satisfactory results obtained.

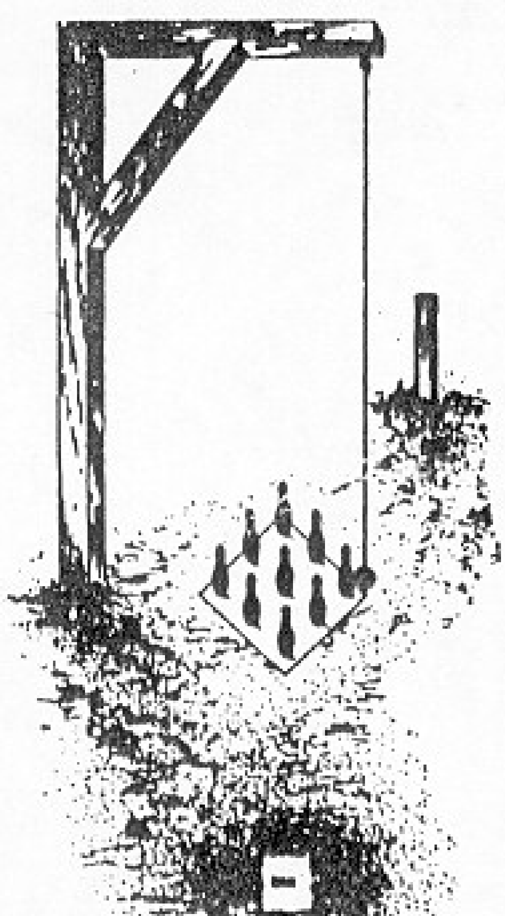
The instrument, when scientifically constructed, furnishes a method for standardizing light intensity under the control of a calibrated rheostat. Light aperture and color density from standardized filters are determinable factors that enable various observers to obtain similar light conditions.

POPULAR MECHANICS

SWINGING BOWLING.

January 18, 1902.

Swinging bowling is being introduced from Germany where it is very popular. The apparatus is inexpensive and can be



easily erected by anyone having a few simple carpenter's tools, and there is room in nearly every factory yard. By choosing sides it affords fine sport during the noon hour, and really requires more skill to make a good score than might be imagined.

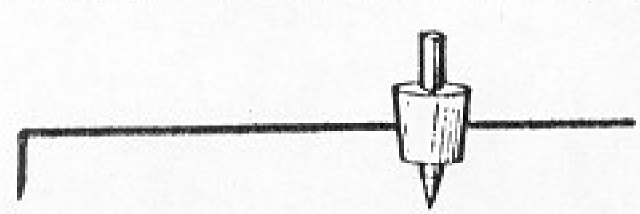
Our illustration, taken from the Florist's Review (florists are famous bowlers) gives a good idea of what the alley looks like. The rules gverning this game are as follow: The party bowling is to stand in what is called the box, with one foot therein, but may change his feet from right to left, as he may see fit, in order to get certain pins. The ball should swing around the pole on the right side and knock the pins down on the return.

In order that the bowling be perfect the dimensions have to be very accurate; otherwise some individual pins may be either taken too readily or not at all. The pin nearest the ball is the hardest to take; therefore one-quarter of an inch variation is a very important matter. The rope goes through the ball, leaving about three inches of rope underneath for the purpose of handling.

A CHEAP COMPASS.

August, 1902

To make this inexpensive compass all that is needed is a large cork (or rubber), a piece of stiff wire and a short pencil says American Miller. The wire should be about eight inches long and should be



bent to a right angle one inch from the end, and the end sharpened. The pencil is fitted vertically in the cork (or rubber), and the latter clamps the wire tightly and may be moved in or out to make a small or large circle, as desired.

A Small Working Pile Driver

Popular Mechanics — 1919

By EDWARD A. KRUEGER

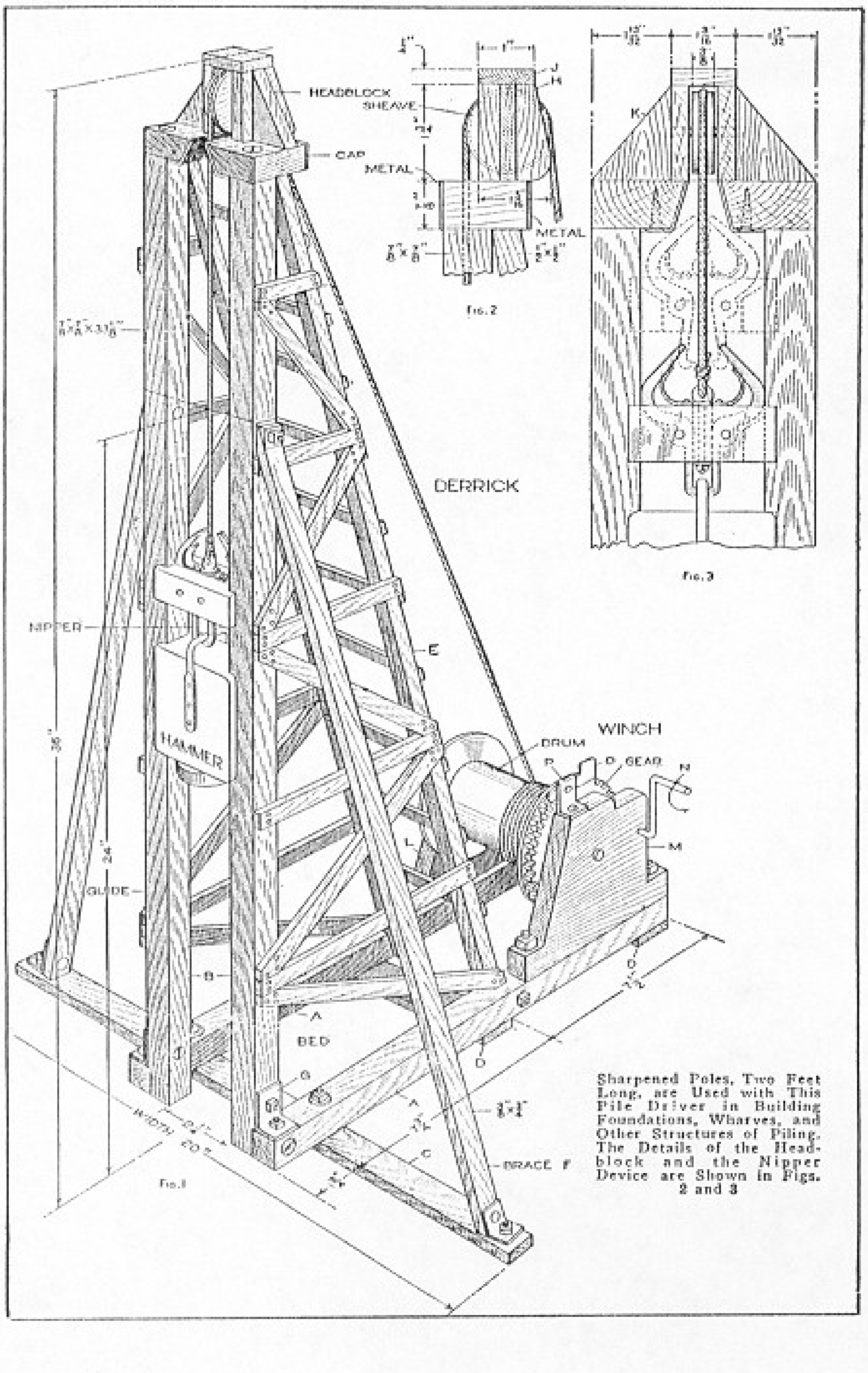
[These directions will enable boys of varying skill with tools to make a pile driver, as a toy or model. Several simple methods of making the parts in the home workshop, with materials easily obtainable, are suggested.—Editor.]

THE construction of small docks, wharves, piers, and foundations for bridges, buildings, and other structures, by the driving of piling is interesting out-of-door play, in which boys will find much fun. A pile driver for this work is shown in the page plate, Fig. 1. The hammer is raised by means of a winch, and is dropped automatically when it reaches the cap of the derrick, as indicated in Fig. 3. The drum is then released, and the weighted double-hook nipper drops down, picking up the hammer on the next upstroke. A single-hook nipper, that can be made easily of wire, is also shown in the detail sketch, Fig. 6. The small boy who cannot make the nippers or the winch, may tie the rope directly to the hammer, drawing it up by hand, and dropping it as desired. The hammer need not be fitted to the guides, but merely arranged to drop between them, and the derrick can be made of only a few main pieces. The larger parts of the hammer and nipper weight are best made of lead, babbitt, or white metal, as these may be cut or melted readily. Iron, brass, or copper, solid or in plates, may be used, if means for shaping them are at hand.

The making of the derrick may be undertaken first. Make two pieces for the bed A, ⅞ by ⅞ by 17 in.; two hammer guides B, ⅞ by ⅞ by 33⅛ in.; one bed piece, C, ⅜ by ⅞ by 20 in.; two bed pieces, D, ⅜ by ⅞ by 5¼ in.; two posts, E, ½ by ½ by 34½ in.; two braces, F, ⅜ by ¾ by 26½ in. Cut these pieces slightly over their finished lengths as given, allowing for trimming and fitting. Make strips, ¼ by ½ in., for the bracing on the sides of the derrick and the ladder bracing on the back.

Notch the lower ends of guides B, ⅛ by ⅞, and the lower ends of posts E, on an angle, ⅛ in. deep, to fit pieces A. Join the parts of the bed, as shown in the page plate, pieces A being set 3½ in. apart, fastening them with bolts or screws. Make braces G, of sheet metal, and bolt them in place. Fit the posts E into place, and fasten them at the bed and the top. Put on several ladder braces temporarily, to steady the frame. Fit the braces F carefully, and bolt them in place. Remove the piece C and the braces F, and nail the horizontal bracing to the sides of the frame. Then fit and nail the diagonal braces. The bolted construction is convenient in "knocking down" the derrick for storing it. Reassemble the parts, and make the cap for the headblock.

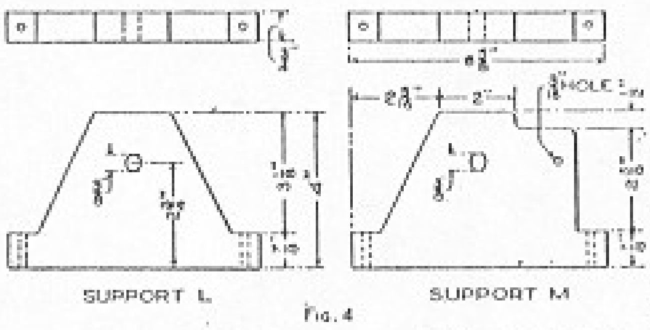
The headblock and cap are shown in



Sharpened Poles, Two Feet Long, are Used with This Pile Driver in Building Foundations, Wharves, and Other Structures of Piling. The Details of the Headblock and the Nipper Device are Shown in Figs. 2 and 3

detail in Figs. 2 and 3. Make two pieces, H, $\frac{1}{4}$ by $1\frac{5}{16}$ by $1\frac{3}{4}$ in.; one piece, J, $\frac{1}{4}$ by 1 by $1\frac{3}{16}$ in.; two braces, K, $\frac{1}{4}$ by $1\frac{13}{32}$ by $1\frac{3}{4}$ in. Make the two beveled pieces of the cap $\frac{7}{8}$ by $1\frac{3}{4}$ by $1\frac{1}{2}$ in., and provide a wooden strip or metal plate for the front and rear edges, as shown. Fasten strips of sheet metal to the bevel of the notch, to protect it from wear by the striking of the nipper hooks. Make the sheave $1\frac{1}{2}$ in. in diameter and $\frac{3}{8}$ in. thick, with a groove for the rope. Assemble the parts, as shown.

The details of the winch are shown in Figs. 4 and 5, and the method of assembling the parts, in Fig. 1. The drum may also be driven without gears by fixing the crank directly to the shaft. Gears may be obtained

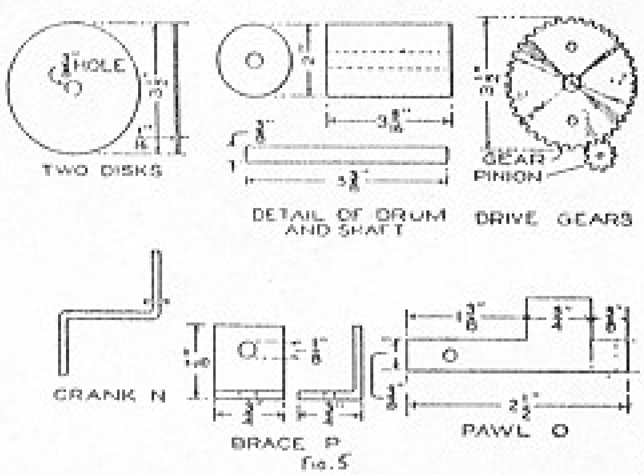


The Supports of the Winch are Made of $\frac{3}{4}$-Inch Wood, Bolted to the Bed

from old machines, or purchased from dealers in model supplies. Make the supports L and M, Fig. 4, $\frac{3}{4}$ by 4 by $6\frac{5}{8}$ in., cutting patterns of paper, if desired.

The gear, Fig. 5, is $3\frac{1}{2}$ and the pinion $\frac{3}{4}$ in. in diameter. The drum is of wood, 2 in. in diameter and $3\frac{5}{16}$ in. long. Its ends are $3\frac{1}{2}$-in. metal disks, fastened with screws. The shaft is a $\frac{3}{8}$-in. bolt, $5\frac{3}{8}$ in. long, and bears in holes bored in the supports, as shown in the details of these parts.

The crank N, Fig. 5, is made of a $\frac{3}{16}$-in. rod, bent as shown, and fitted with a washer to fit next to the pinion. The gear is set by means of the pawl O, which is bent from a strip of $\frac{1}{16}$-in. sheet metal. The brace P is bent from a $\frac{1}{16}$ by $\frac{3}{4}$ by $1\frac{5}{8}$-in. strip of sheet metal, and riveted to the pawl. Assemble the parts, fastening the gear to

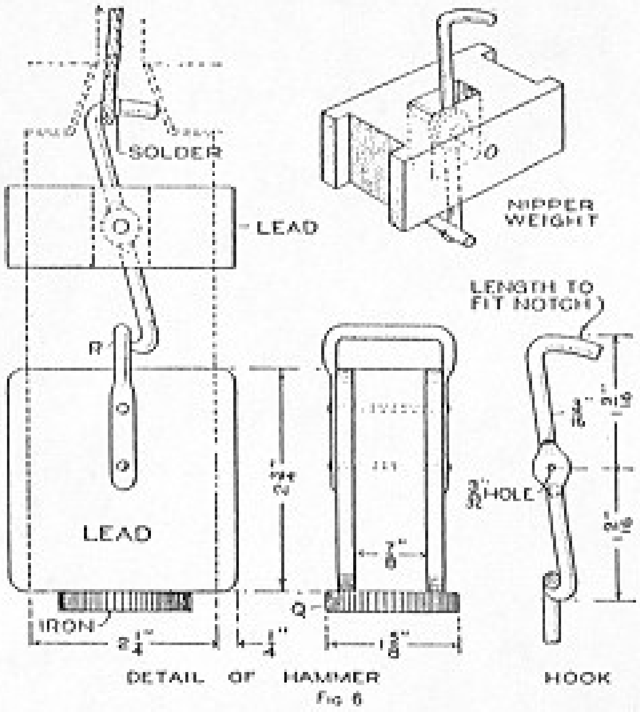


Details of the Drum, Its Driving Mechanism, and Fittings

the drum end, and bolt the supports into place. Put the pinion into mesh with the gear at its proper place, and carefully mark the hole for the crank. Square the end of the crank and the hole in the pinion, and fit them to a driving fit. Fix the rope to the drum, and reeve it through the head block. The derrick is then ready for the hammer and the weighted nipper.

The hammer, shown in Fig. 6, may be made easily from a solid block of lead, $1\frac{1}{4}$ by $2\frac{5}{8}$ by $2\frac{5}{8}$ in. Cut $\frac{3}{16}$ by $\frac{7}{8}$-in. grooves in the vertical edges to fit the guides. Make the circular $\frac{3}{16}$ by $1\frac{5}{8}$-in. hammer plate Q of iron or brass, and fasten it with screws. Rivet the wire lifting strap R, as shown.

The single-hook nipper, shown in Fig. 6, is made as follows: Flatten a



A Simple Method of Making the Tripping Device, and Details of the Hammer

piece of $\frac{3}{16}$-in. wire at the middle, and drill a $\frac{3}{32}$-in. hole for the bolt. Shape the lower end into a pointed hook, and bend the upper end to form the trip arm. This strikes the notch in the cap of the derrick, releasing the hammer. The rope is wired to the hook as shown. The nipper weight is made of a solid piece of lead, $1\frac{1}{4}$ by $2\frac{5}{8}$ in., by 1 in. high, grooved at the ends to fit the guides. Cut a slot through it, for the hook, as shown in Fig. 6, and bolt the latter into place. The double-hook nipper is better mechanically, and may be made of two pieces of wire, or cut from sheet metal.

Test the action of the nippers, and bend or file the hooks to operate properly. The pile driver may then be painted, and work on "jobs" begun. If it is used at the water, fix metal guards at the lower ends of the guides, to prevent the hammer from falling into the water.

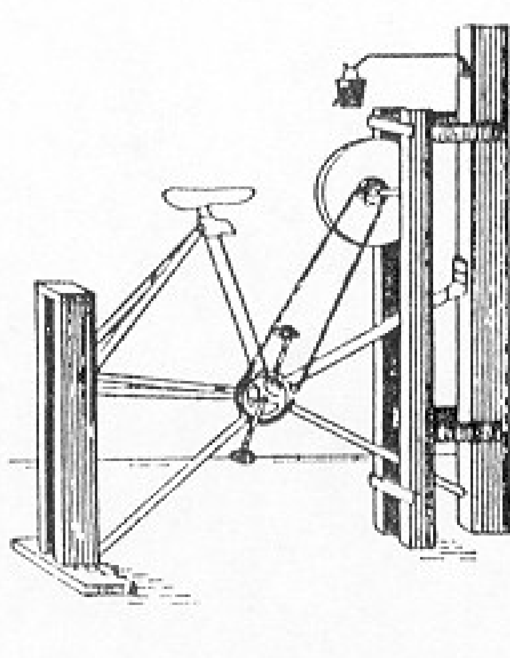
POPULAR MECHANICS

February 1, 1902.

A GRINDSTONE SCORCHER.

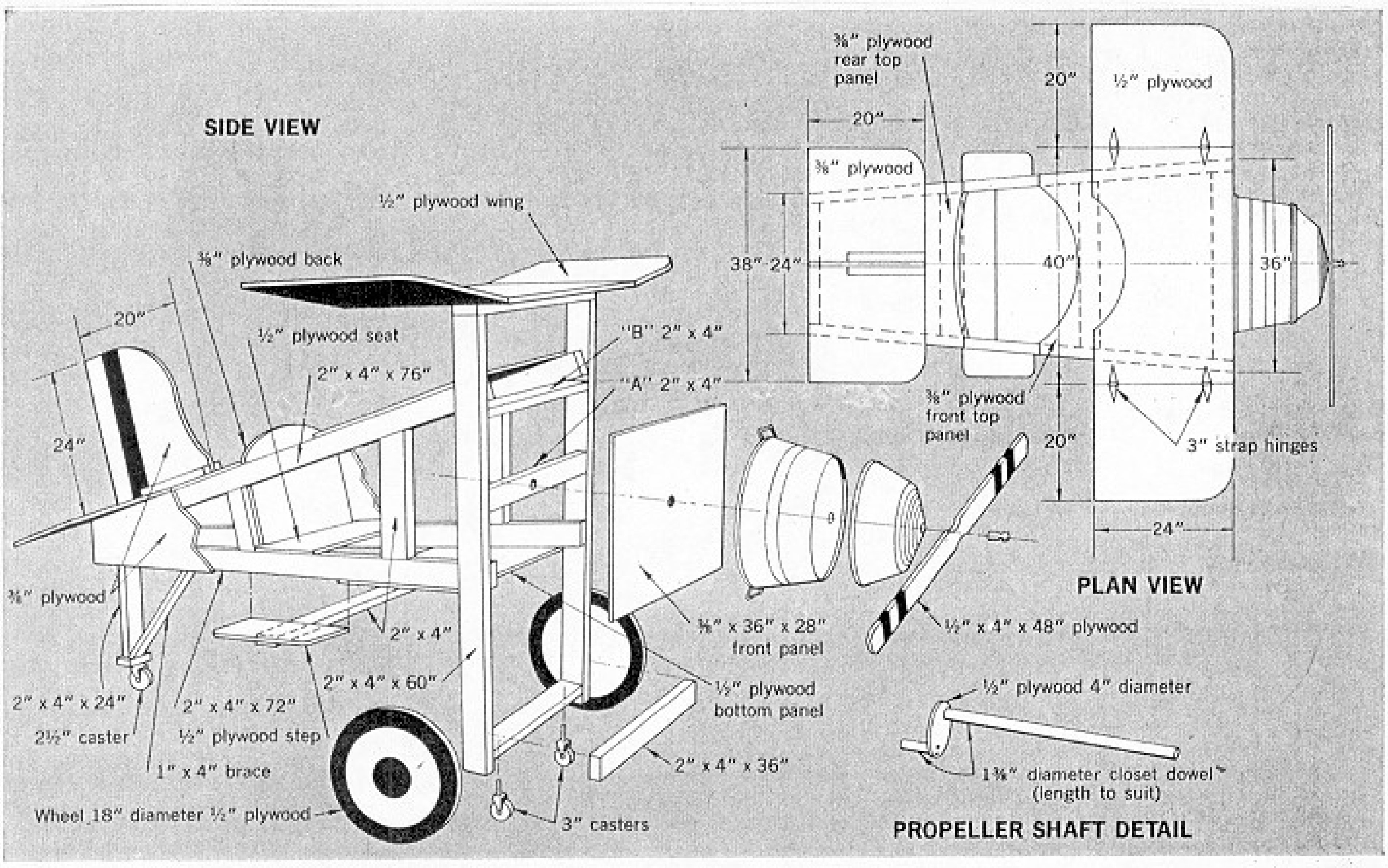
A new use for bicycles has been discovered. It is to run grindstones with them. John Arrowood, the first to transform the wheel in this useful piece of mechanism, tells the American Blacksmith how it is done:

"I had the frame of an old bicycle and used it in connection with the stone. I first cut out the middle brace of the bicycle and with a 2 by 4 timber made the rear support. Next I stapled the front of the bicycle to a stout post and then made the



frame of the grindstone. I braced the bicycle frame underneath. By cutting the spokes out of the rear wheels I secured the small sprocket. I then fitted a small piece of wood into the square hole of the grindstone, bored a hole in the wood the size of the sprocket axle and fitted the axle to the stone. I cut notches in a piece of iron for the axle to rest in and nailed the iron to the frame. As the stone was quite high, it was necessary to obtain two chains and put them together.

"The machine is now a handy ball-bearing grindstone, which runs at lightning speed and cost but little to make."



This play airplane *has a sturdy 2 by 4 frame and is covered with exterior grade plywood. It's a good project for using scrap lumber*

It's a Sopwith Camel…almost

Sunset MAY 1965

The fighter planes of World War I inspired this big, brightly colored play airplane with its pilot-controlled propeller. Though not a copy (the War I fighters were biplanes), you could say it is reminiscent of a Sopwith Camel or perhaps a Nieuport. Whatever the ancestry, it attracts children like a magnet.

Owner-designer Barnaby Conrad, of San Francisco, built it from materials on hand. If you bought everything from scratch, you would probably pay about $40.

Framing: You need about 65 feet of construction grade 2 by 4-inch lumber.

Top and side panels, seat back, horizontal stabilizer, tail: Cut from two 4 by 8-foot, ⅜-inch-thick, exterior plywood panels.

Seat base, bottom panel, propeller, wing, wheels, steps: Cut from a ½-inch-thick panel (see diagram above).

Nose and cowling: The nose is a standard 18-gallon galvanized washtub. The cowling is part of a discarded light fixture.

The plane rolls on three rubber casters; for lawn use, you could substitute 2 by 4 skid bars. Two pairs of 3-inch strap hinges hold the folding wing ends, letting you wheel the plane through garden gates. You'll also need one 4-foot length of 1⅜-inch closet dowel, nine 3½-inch and two 6-inch carriage bolts, nails, and paint.

BUILDING THE PLANE FRAME

The body tapers from nose to tail. Cut the long 2 by 4's to dimensions shown on the plan, and cut shorter cross-pieces and vertical braces to fit along the fuselage at 2-foot intervals.

For extra strength, bolt the tail wheel support and its brace (bolt the upper end of the brace to a 2 by 4 crosspiece, especially positioned for this purpose). Bolt the step support (a 2 by 4 that projects 6 inches on each side of the fuselage) to the frame with large bolts; then bolt the steps in place.

To stiffen the frame at the rear, nail a piece of ⅜-inch plywood across the ends of the lengthwise frame members.

COMPLETING THE INSIDE WORK

Cut out the plywood parts to fit the frame. Nail in the cockpit seat back; it nails to a pair of vertical 2 by 4 crosspieces. The seat fits as shown in the diagram; a cushion will make it higher and softer.

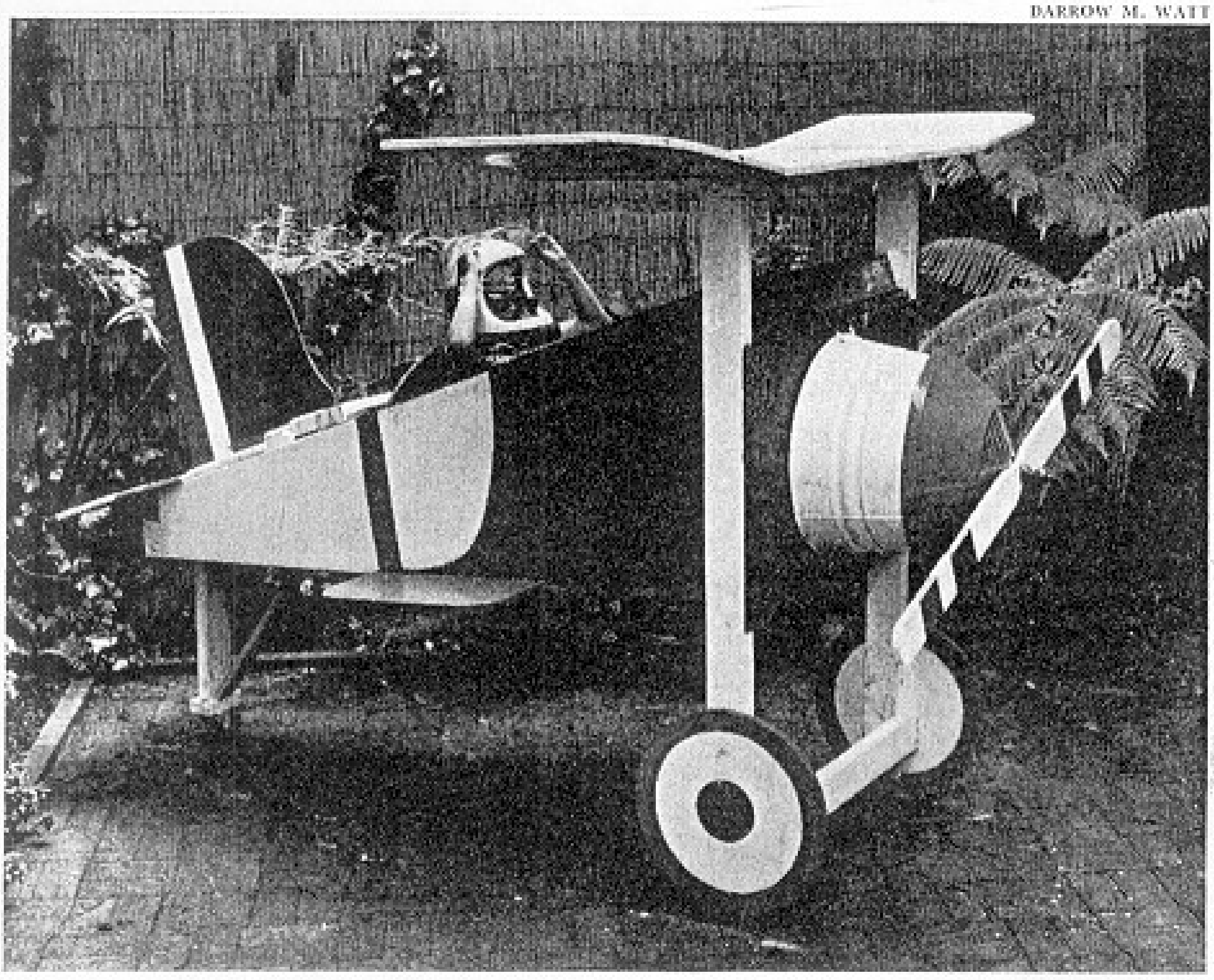
To build in the propeller mechanism, add a hand crank to the 1⅜-inch diameter axle, then drill a 1½-inch hole in axle support member **A**. While holding **A** in place, slide the axle through its hole from the inside. With the shaft parallel to the lower frame members, adjust **A** to a height where the pilot can turn the crank easily without rapping his knuckles on the top panel. Then nail **A** in firmly.

Nail in **B** a few inches above it in correct position to serve as a foundation for the staples or nails that secure the top handle of the washtub "nose."

Make a hole for the propeller axle in the center of tub and cowling, and fit them in place. If the cowling you use is sheet metal, you can attach it to the washtub with sheet metal screws.

Now have your young pilot slide the axle forward until it's comfortable, and cut off its end flush with the cowling. Cut the

DARROW M. WATT



Paint job *is a bright red, white, and blue; use a primer first, then exterior enamels*

propeller to the design you like, and fasten it to the axle with long wood screws. Cap it with a decorative knob (a wood door stop will do nicely).

WHEELS, TAIL, AND WING

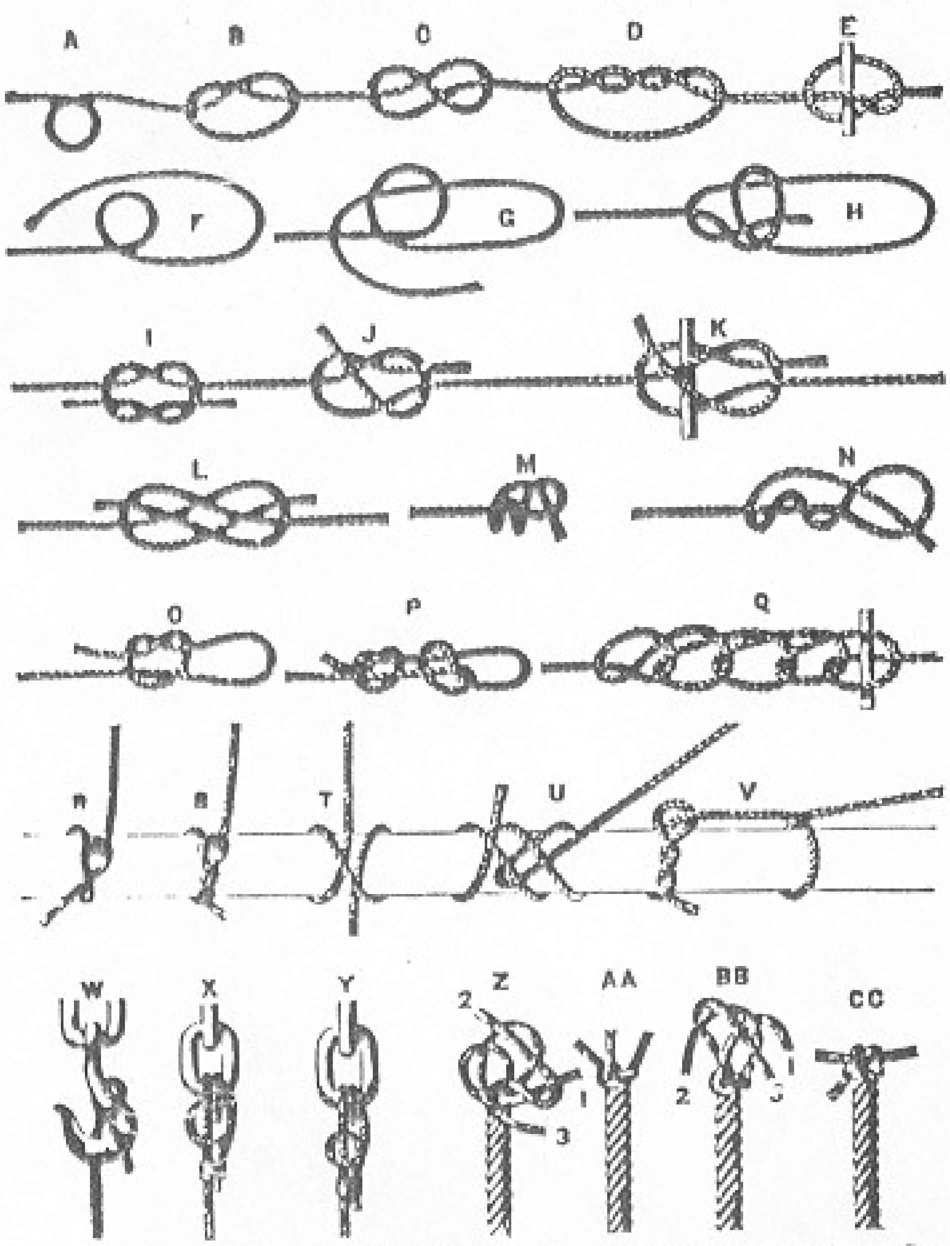
The large wooden wheels don't turn; the plane rolls on casters. Screw two casters (3-inch diameter) to their 2 by 4 support; then nail the fake wheels in place about an inch off the ground. Screw a small plywood block to the bottom of the tail support, and attach the rear caster (2-inch diameter) to it.

Now nail on side and bottom panels, horizontal stabilizer, and rear top panel, which is cut to cover the frame from stabilizer to cockpit. Center the tail on top of these two panels, and anchor it with 2 by 2's along each side, or use L-shaped shelf supports.

To give the wings their jaunty tilt, saw the outer edges of the center wing section at a slight angle, or add shims; then attach end wing sections with hinges (use rust-resistant ones).

Knots You Ought to Know

POPULAR MECHANICS



Copyright 1904. Courtesy C. W. Hunt Co.

A.—Bight of a rope.
B.—Simple or Overhand Knot.
C.—Figure 8 Knot.
D.—Double Knot.
E.—Boat Knot.
F.—Bowline, first step.
G.—Bowline, second step.
H.—Bowline, completed.
I.—Square or Reef Knot.
J.—Sheet Bend or Weaver's Knot.
K.—Sheet Bend, with a toggle.
L.—Carrick Bend.
M.—Stevedore Knot completed.
N.—Stevedore Knot commenced.
O.—Slip Knot.
P.—Flemish Loop.
Q.—Chain Knot, with toggle.
R.—Half-hitch.
S.—Timber-hitch.
T.—Clove-hitch.
U.—Rolling-hitch.
V.—Timber-hitch and Half-hitch.
W.—Blackwall-hitch.
X.—Fisherman's Bend.
Y.—Round Turn and Half-hitch.
Z.—Wall Knot commenced.
AA.—Wall Knot completed.
BB.—Wall Knot Crown commenced.
CC.—Wall Knot Crown completed.

DEVELOPING STREAMS FOR WATER POWER

by JOHN S. CARPENTER, Hydraulic Engineer
Mechanical Package Magazine — 1931

A description of the engineering procedure in surveying a stream and measuring its power possibilities is given here by a prominent hydraulic engineer who has designed many damming projects.

IN ORDER to develop a water power, it is first necessary to know what one has before buying any material whatever. Nature did not standardize in either the fall or the quantity of flow when giving us our streams, so in all cases the water wheel must be fitted to the stream.

The first important thing is to know what fall can be obtained. The engineer calls this "the head" and measures it in feet. Drive a stick in the

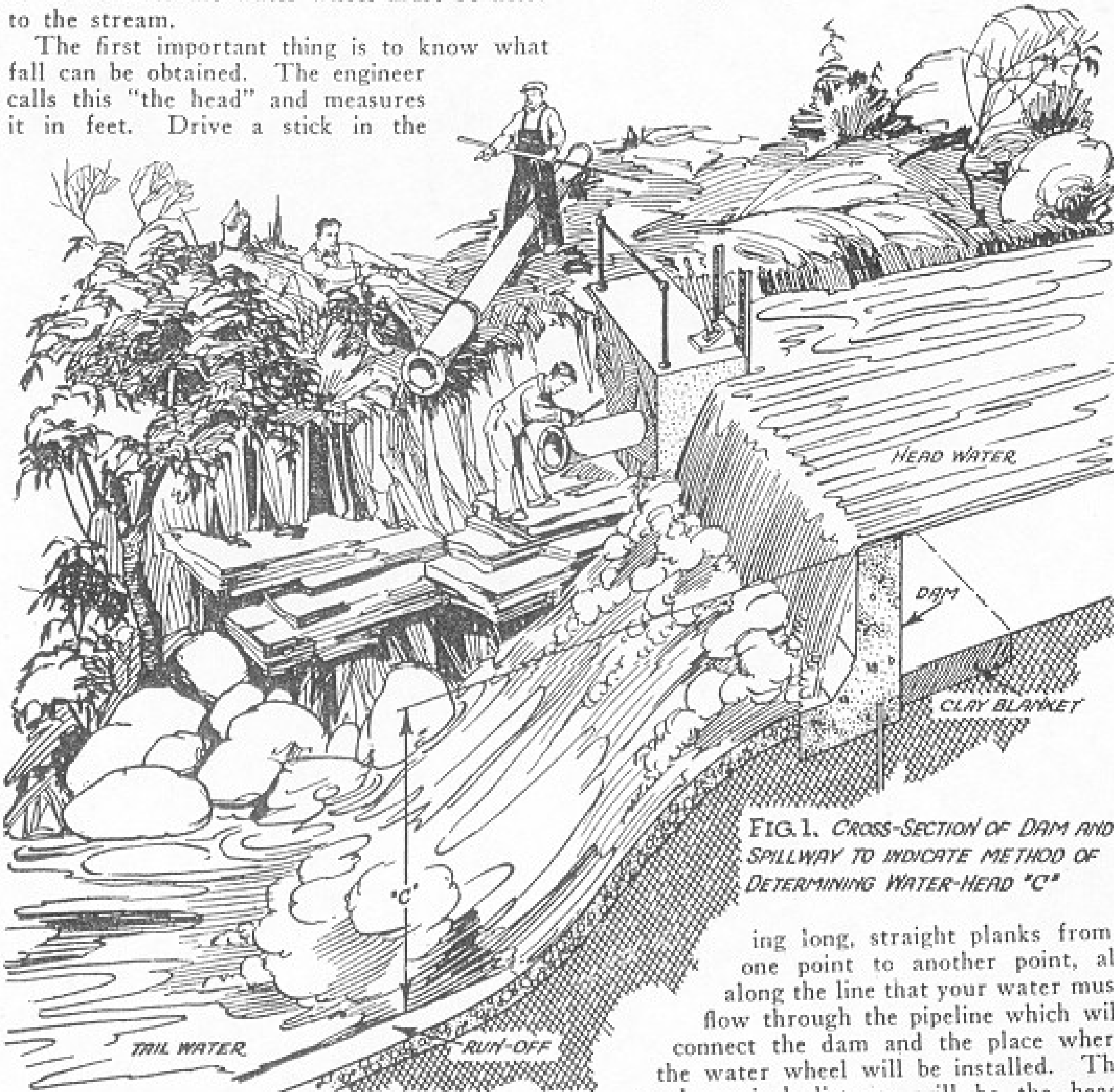


FIG. 1. CROSS-SECTION OF DAM AND SPILLWAY TO INDICATE METHOD OF DETERMINING WATER-HEAD "C"

By driving a stick in the ground to the height where water can normally be backed up, and measuring the fall, "C", is the first step in calculations.

ground, the top of which will represent maximum height to which you can back up the water in ordinary times. Remember, you cannot flood your neighbor's land without his consent. Now find the lowest level on your property to which the water can drop and still flow off. The vertical distance between these levels is the gross head. See Fig. 1. You can measure the head either by a surveyor's level, or by using a carpenter's level and leveling long, straight planks from one point to another point, all along the line that your water must flow through the pipeline which will connect the dam and the place where the water wheel will be installed. The total vertical distance will be the head. It will be better to have a surveyor do this work if the distance is long, as it is only too easy to make serious mistakes.

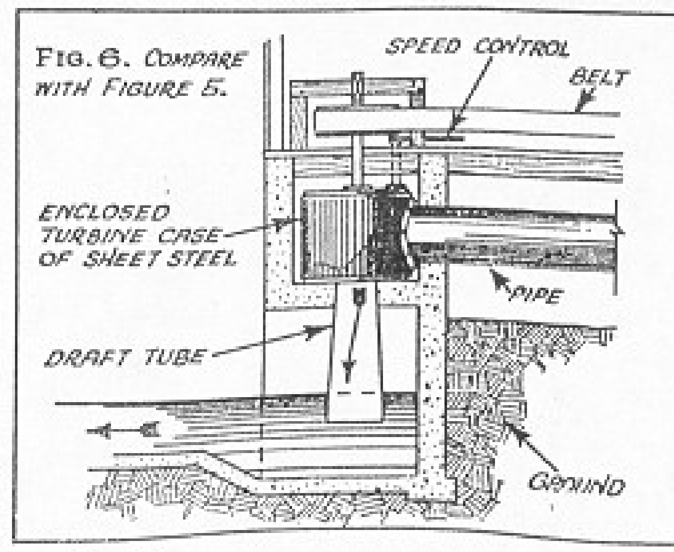
The next important thing is to find out how much water flows per second. Here is where you must use judgment. The flow is not the same all year around. The idea is to get a

rate of flow in cubic feet per second that can be fairly well depended on. By experience you will know the usual level of the water flowing in the creek.

Select a stretch where the width and the depth of the stream are fairly uniform. Even though a little digging is required to get this condition, it is worth while doing the work. Measure the average width and the average depth of the stream, in feet and decimal parts of a foot. See Fig. 2. The product of the two will be the area of the stream in square feet. For example, if the stream averaged 6 ft. wide and 2 ft. deep, the area of the stream will be 12 square feet.

We must now find the velocity, or the distance that the water flows in one second. To a small block of wood, tie a small stone with a cord, heavy enough that the block can be seen floating level with the water surface, Fig. 3. Put a small flag on the block so it can be plainly seen as it floats along with the current. The cord should be long enough so that the stone will be hanging at about two-thirds of the stream depth. Measure off a known distance along the stream, in feet. Using a stop watch, or less good, the second hand of a watch, time the floating block to see how long it takes, in seconds, for the block to travel from one end of the known distance to the other end. For example, if the known distance is 50 feet, and it took the block 25 seconds to travel that distance, the block is traveling 2 feet per second, which is the velocity of the water. Divide distance in feet by the number of seconds and the result is velocity in feet per second. Carry answer out to one decimal place.

For heads of water higher than 20 feet, the turbine is enclosed in a sheet steel case with shaft running through stuffing box of power take-off above.



To find the number of cubic feet flowing per second, we multiply the stream area in square feet by the velocity of flow and the result is cubic feet per second. For example, above explained, we found an area of 12 square feet. If the velocity was 2 feet per second, there is a water flow of 24 cubic feet of water per second. So, to get the water quantity flowing, we multiply the square feet stream area by the velocity in feet per second.

We can now find the horsepower that the stream will develop. If the head found, as before explained, was eight feet, we will find that this stream will develop 16 horsepower. To get the horsepower, we multiply the head in feet by the number of cubic feet per second and then divide by 12. This result is now in horsepower. The figure 12 is called a constant, because it takes into account the transformations from one unit to another. It also makes allowance for the usual losses in friction met with in small plants. As the above rate of flow is the constant rate, you may figure on so

TURBINE IN CONCRETE BOX CAN BE LOCATED ANYWHERE

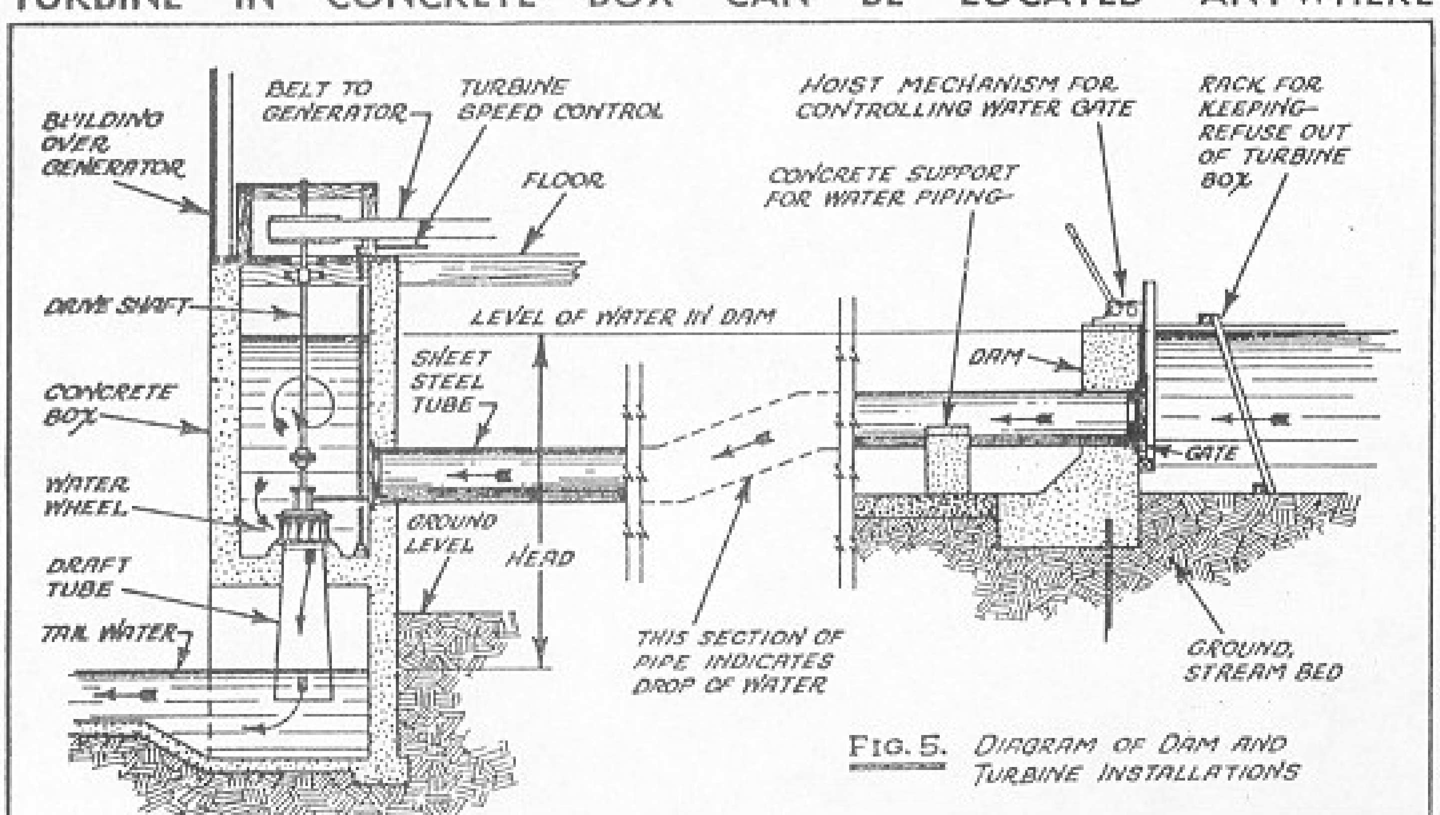


FIG. 5. DIAGRAM OF DAM AND TURBINE INSTALLATIONS

This shows the way a turbine may be located on more convenient ground, away from the dam for better discharge facilities. The turbine is set in a box. The water level in the box is maintaind by a pipe to the dam. The turbine may be midway in the head, but by the use of a draft tube it may have full benefit of the total head. The turbine speed control is had by valving the inlet water.

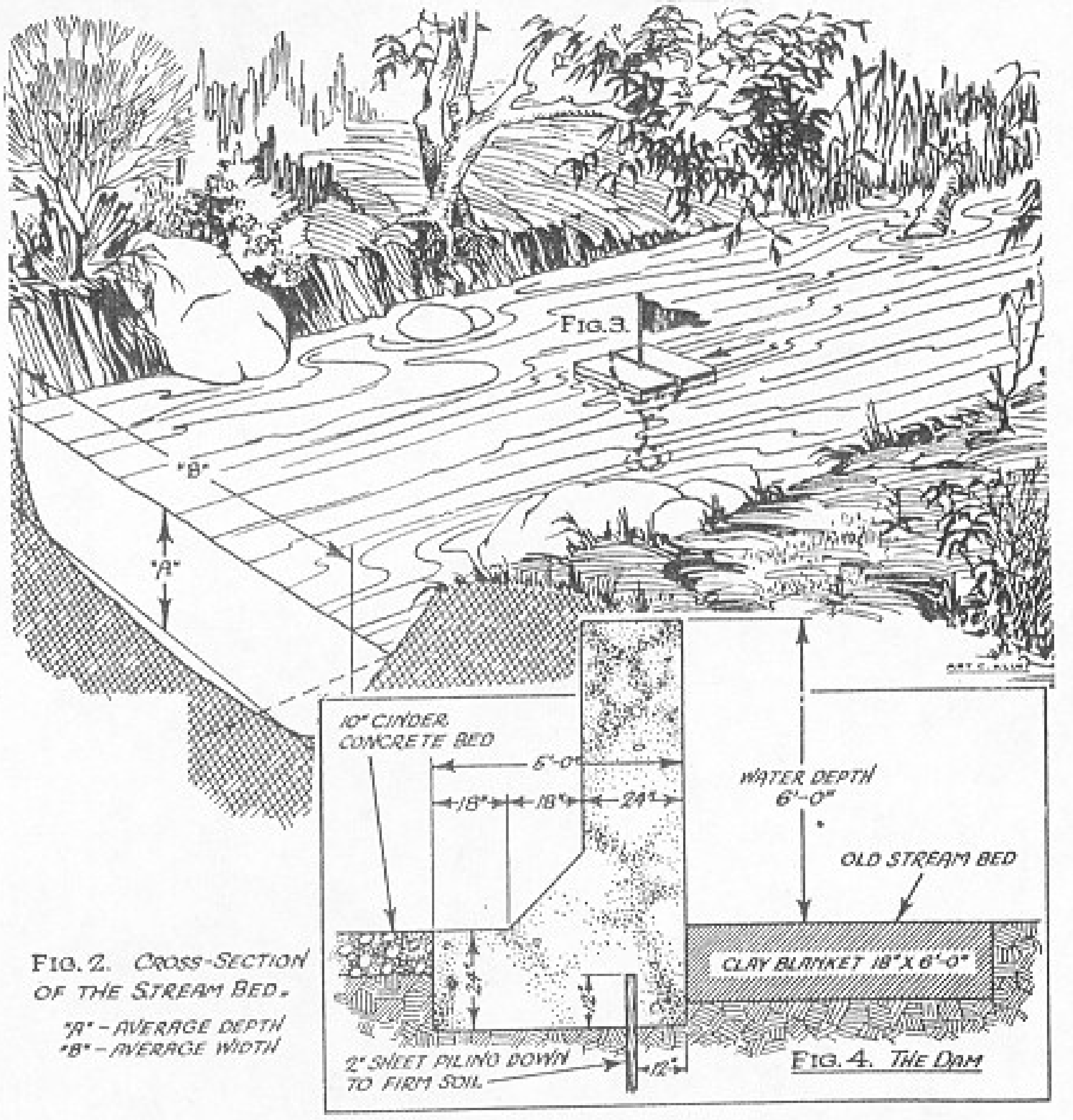


FIG. 2. CROSS-SECTION OF THE STREAM BED.
"A" - AVERAGE DEPTH
"B" - AVERAGE WIDTH

The second step is to find how much water flows per second. The idea is to get the rate in cubic feet per second that can be depended on as an average all year 'round. The cross sectional area of the stream is found as a product of the mean depth "A" and the mean width "B". Distance water flows per second is found by timing weighted float, Fig. 3.

By means of a tremie for pouring under water the concrete for this typical dam can be poured. Dam will impound a 6-ft. head. Piling prevents undercutting, as does the clay blanket.

much constant horsepower. If your water supply is not enough for constant work, and you can store the water as it flows in, you could use three times the normal flow for eight hours of use, or six times the normal flow for four-hour use. Such a condition would be met in furnishing lights at night for about four hours.

Now we can write several water wheel manufacturers for competitive prices on the turbine water wheel we will need and whatever belting or gearing may be required to drive the machinery. Names of these manufacturers can be obtained from the publishers of this magazine. In your letters state the kind of machinery you wish to drive and its r. p. m., if you know it. You will then receive prices on what you need. The manufacturer you buy from will be glad to furnish blueprints showing everything that you will require built by the contractor. The next step in order is to build the dam. On small plant locations it is seldom necessary to build a dam more than 6 feet high, to raise the water an equal amount. Some study should be given to the matter of building the dam with storage capacity, if the normal flow of water is widely varying. The dam can be made of wood, earth, masonry and concrete. As a rule, it will be found that a concrete dam is the cheapest and most reliable. A concrete mixture of 1 part of cement, 2½ to 3 parts sand and 5 to 6 parts of broken stone is economical and strong. It is often asked: "Is a dam 900 feet long just as safe as a dam 9 feet long?" The answer is that the length of a dam does not enter into its strength. The easiest type of dam to build is the gravity type, which resists overturning by its mere weight alone. In some rare locations, it is possible to build very thin dams between solid rock side walls, but this is costly and such dams are usually open to doubts as to their safety unless constantly watched. In Fig. 4, details are shown for a dam to raise the water level six feet. Even if your dam needs to be only four feet high, it would not pay to make the thickness less than for six feet as it is very convenient to use the crest of the dam as a walkway. If you can do so, drive two-inch sheet piling at the base of the dam as shown to stop subsurface leakage and avoid washing out

eventually. If you cannot drive sheet piling, and should have trouble later with leakage, a clay blanket avoids much trouble. This blanket should be laid against the wet side of the dam. If you have a stream that goes into floods at certain times, you must use a part or all of the crest of the dam as a spillway. Then you must provide a stone bed for the falling water to break on, thus preventing scouring out under the dam.

In order to keep the water wheel from clogging it is necessary to keep leaves and branches out of the water. In most cases, you will find that you can buy a wrought iron rack from the water wheel builders so cheaply that it will not pay you to build a wooden rack for this use. These racks are, in effect, like screens, and can be cleaned with a long-handled garden rake.

In all but very few cases, it will be found that the cheapest way to carry the water from the dam to the water wheel is by the use of riveted sheet steel pipe. This pipe can be bought painted or galvanized, straight or with bends and reducing sections, in lengths up to 20 ft. The lengths are often provided with flanges on each end so that they can be bolted up end to end to make up the complete pipeline. Specify how many feet of pipe you will need, from the dam to the water wheel. The manufacturers will tell you what size pipe is needed for your particular case, as the length of the pipe has a bearing on the size. One of the great advantages of sheet steel pipe is the great amount of leakage saved.

The upper end of the pipe, where it projects through the dam, should be furnished with some type of wood slab water gate that can be easily raised and lowered, so that the water can be shut off entirely from the pipe if it is desired to do work in the wheel pit or box. These gates can be furnished with hoisting irons as shown in catalogs of manufacturers, to work with a ratchet and bar.

Where the fall is less than eighteen to twenty feet, it will be cheapest to have the pipe, bringing the water from the dam, discharge into a concrete pit or box with an open top, the water level in the box being at the same height as in the dam. See Fig. 5. The water wheel is placed on the floor of this box, in the center of same, so that the water enters the wheel around its outside circumference, and flows through the wheel and out to the run-off ditch through a relatively short steel pipe called a draft tube, which must be air-tight. Thus the turbine water wheel can be set above the run-off ditch some five to ten feet, depending on the amount of head, and still take advantage of the whole head by the vacuum in the draft tube.

Where the fall or head is more than twenty feet, it is usually cheaper to have the turbine built into a sheet steel case so that the steel pipe can be connected directly to this case and thereby avoid building very high concrete turbine boxes. See Fig. 6. The water wheel shaft will then project through this steel case and then can be directly belted or geared to the machinery to be driven. In the case of the open concrete box, the turbine water wheel shaft will have to go a few feet above high flood water, and then can be belted or geared to drive electric generators and the like.

For plants up to a capacity of say, eight horsepower, it is hardly necessary to have a governor that regulates automatically. The speed of the water wheel can be regulated by hand and you will soon get so used to doing it that you will do it like running your automobile. Larger plants should have an automatic governor as there is then too much load varying all the time for one person to keep track of.

POPULAR MECHANICS

HOW SNAILS ARE RAISED.

March 29, 1902.

Paris consumes 800,000 tons of snails every winter. With Burgundy, the two departments of Savoy, are the greatest suppliers. They are bought at the rate of 8 to 9 francs ($1.80) per thousand. They are first sent to Auxerre in order to be resold at Paris as coming from the vineyards of Dijon and Macon. Some intelligent speculators have a certain manner of raising snails. They huddle them together in pans built of smooth planks coated with tar, in order that the molusk may not be able to climb the length of the wall.

In the olden times at Rome there were raisers of snails who used degrees of refinement that are now among the lost arts. It is thus that a certain Fulvius Merpinus, according to Pliny, nourished his snails on flour and wine and they were particularly appreciated by the Roman epicures.

HOW EXCELSIOR IS MADE.

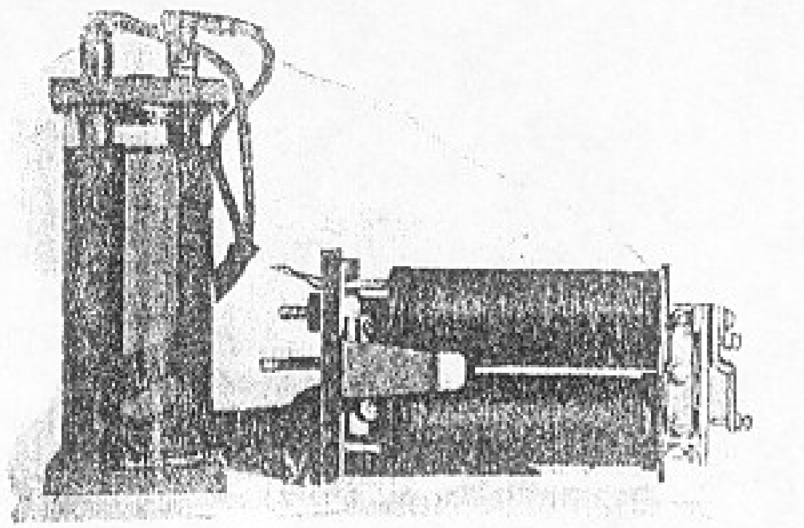
May 3, 1902.

Excelsior, which is an American invention, is made of bass wood and poplar. The logs are sawed into eighteen inch lengths and split in halves. A series of knife points run down the face of the block, cutting into the wood in parallel lines that are spaced according to the width of the fiber to be made. A following knife slices off the whole face of the block thus served. The fibers curl and commingle as the knife sets them free. An excelsior machine makes two hundred to three hundred strokes a minute, every stroke cutting off a tier of fibres across the face of the block.

Build Your Own PHOTO-ELECTRIC CELLS

by RAYMOND F. YATES

Mechanical Pkg. Magazine 1932



All of the newer wizardry of photo-electricity is easily demonstrated with this liquid cell which can be made for less than fifty cents.

WE HAVE all been reading about the two hundred or more industrial uses that have been found for that modern jack-of-all-trades, the photo-electric cell which is a device capable of generating a small electric current when a beam of light falls upon it. It is really an electric eye that never winks and never closes.

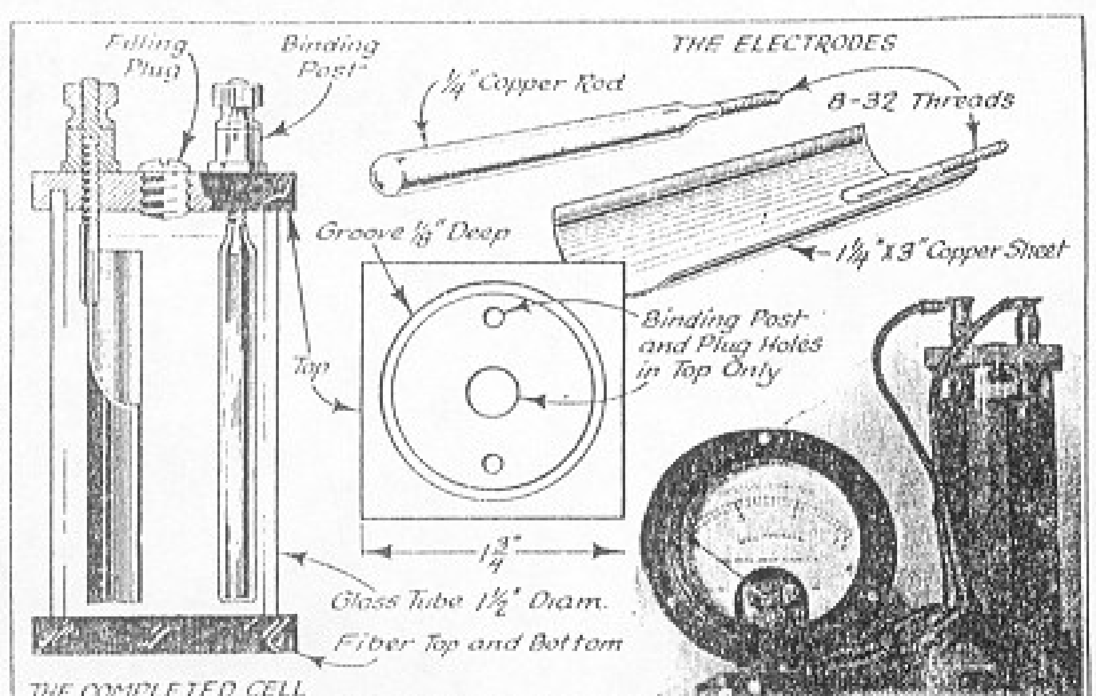
Electrical experimenters, that is the more fortunate ones who can toss off a ten buck note without batting an eyelash, have been buying these marvelous cells and have been having a lot of fun with them. The average experimenter, however, can find many uses for ten iron men and so here goes a description of a photo-cell that will out perform the average vacuum type cell and which may be made at home for the perfectly lousy sum of fifty cents.

With this little cell and a crude relay that may be made out of an old telephone receiver of the thousand-ohm type, the experimenter may conduct all of those remarkable experiments wherein a bell is made to ring at the waves of a hand, etc.

First I want to give credit where credit is due. The design of this cell is due to Dr. Samuel Wein, whom I hold to be one of the greatest authorities on the photo-cell in the United States. The last time I saw him I told him to give me directions for the building of a good cell that would come within the range of every experimenter's pocketbook and something that he could use for closing relays without the necessity of employing expensive vacuum tube amplifiers. This is what he told me and this is what I did:

The bill of materials is pretty simple. Two pieces of fibre will be needed, each piece measuring 1¾ inches square and ¼-inch thick. Then there is two binding posts of the garden variety, a small piece of sheet copper measuring 3 inches by 1¼ inches. A copper rod ¼-inch by 3 inches long. A little Major's Cement, a little asphaltum paint and a glass tube measuring 1½ inches in diameter and 3 inches long completes the bill. And let me say this right here and right now: It is not necessary to build the cell in the form in which I am going to describe it. It may be put in much cruder forms. The electrodes may simply be immersed in a solution held by a pickle bottle. The form I am describing is for those fellows who would like to make some serious experiments and want the cell in its most convenient form. This cell, however, would not be one bit more sensitive than a cell made in a pickle bottle.

I do not really need to say very much about the construction of the cell. The grooves cut in the fibre are filled with the cement and



This cell was designed by Dr. Samuel Wein, who is one of the greatest living authorities on photo-electricity. Above are all the needed dimensions for assembling one of these marvelously fascinating electrical jack-of-all-trades. It is a light, sensitive relay for passing current.

allowed to stand for twenty-four hours after the glass has been set in place. Asphaltum paint is used to cover the binding post screws, the back of the copper (sheet) electrode and the joints between the fibre and the glass. This should be used both inside and outside.

It is most advisable to make the filling plug of fibre and it should make a good fit to prevent the loss of solution. And now for the light-active material.

The copper electrodes are first washed thoroughly in a strong solution of caustic potash. This should be done very seriously for it is absolutely imperative that these plates be clean. After this they are rinsed in hot and cold water to remove every trace of the caustic potash. It should be remembered that the eye cannot be depended upon to determine whether or not the surface of the copper is clean. The washing should be continued in running water for at least one hour to make sure that the last trace of the caustic has been removed. This done, the copper electrodes should thereafter be handled with a clean pair of tweezers for if they are touched with the hand a certain amount of oil will be left.

Now two grains of crystallized copper sulphate are dissolved in 1000 cubic centimeters of pure water. Unless the experimenter is set for chemistry it would be advisable to have this solution prepared at the corner drug store where it may be done accurately and with chemically pure water which is needed.

Then this solution is placed in the cell proper after the electrodes have been mounted in place. The plug is screwed in place and then the cell is set in the sunlight for a period of eight days so that a thin film of cuprous oxide is formed on the surface of the copper electrodes. The cell is then ready for use and may be used to directly close a sensitive relay which will ring bells, start motors and operate solenoids for the performance of different mechanical tricks.

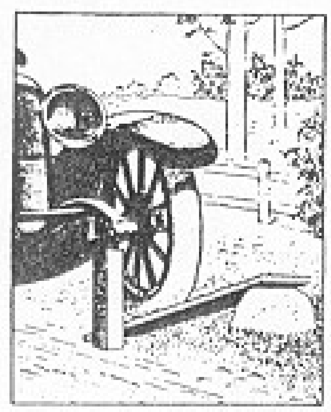
When used with an ordinary 60-watt lamp, this cell should show an output current of about 2 milliamperes when the lamp is about 2 feet away. However, if a 500-watt lamp is used the cell will register the generation of about 10 milliamperes when the light is held this close. It will be found that a rather inexpensive relay may be had that will close on a current of one milliampere with ease. If the experimenter does not wish to go to the expense of buying such a relay he can make one, using the magnets of a thousand-ohm head 'phone.

The primary function of the cell is, of course, to pass a current when light hits it. The relay in turn switches on or off currents from an independent source which can be made as powerful as is needed by the work to be done.

Changing a Motor-Car Tire without a Jack

Mechanical Pkg. Magazine 1932

It occasionally happens that a motorist fails to have a jack at hand when a tire needs to be changed on the road. The situation is easily met with the aid of a strong board and a couple of blocks or rocks. Driving the desired wheel onto the incline, provided in the manner illustrated, and setting the brakes, a block is placed beneath the axle. The board is then knocked out of the way.



POPULAR MECHANICS July, 1903

A HOME-MADE COOKING-BOX.

A cooking-box, which can be made at home with little cost, with which an entire meal can be cooked by means of a single lamp, and which requires no attention from the housewife after the articles are put in to cook, except to take them out when done, is a device described by The Ohio Farmer.

The box is made of pine or whitened plank, one or two inches thick. It should be lined with tin and is better when covered also with tin. The box should be placed on a metal-top table, to which it may be hinged. A 2½-inch hole in middle of the table top affords space for the lamp chimney. A double tube is open at the bottom of the box over the lamp chimney and over the hole in the metallic-top table. This tube may be arranged so that the openings may be merged for quick cooking or closed altogether for slow cooking. The hottest place in the box is directly over the lamp and the next hottest places around the tube.

A convenient size for the box is 14 inches square, with a slant top which allows a tall vessel to be placed over the lamp and still gives room for vessels under the slant which may be cooked slowly.

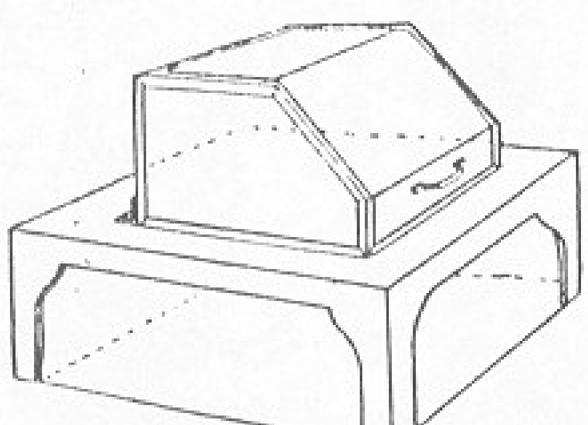


Fig 1—COOKING BOX—Perspective.

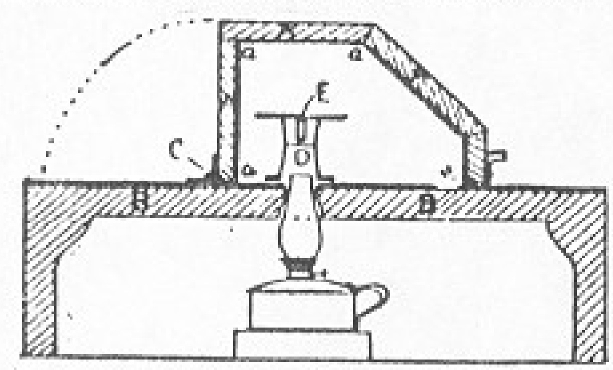


Fig. 2—COOKING BOX—Sectional View; A, A, A, oven; a, a, a, hottest places; B, B, metal table; C, hinge; D, double tube; E, openings.

Homemade Sextant shows How Ships Find Their Way BY THE SUN AND STARS

This Article Tells How to Make and Use an Instrument with Which You Can Find Latitude of Your Own Home

Popular Science Monthly — Sept. 1933

By
GAYLORD JOHNSON

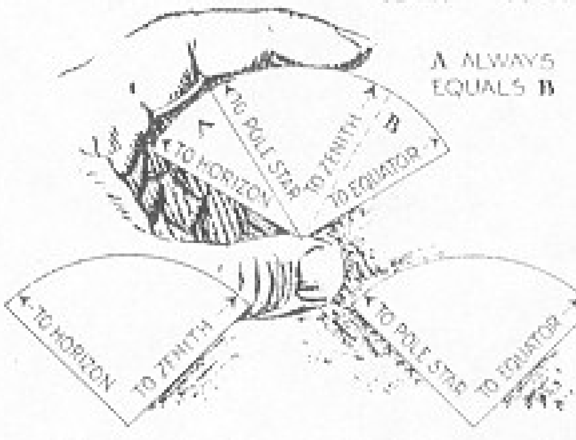


Diagram showing how simple sextant is used to determine latitude from polestar

IF YOU have crossed the ocean, you probably have seen the ship's captain, or his first officer, "shooting the sun." Shortly before noon, he came out on the bridge, sighted toward the horizon for a couple of minutes through an odd-shaped instrument, and disappeared into his chart house.

Had you been watching the bridge at night, you might have seen the same performance repeated while the officer on watch took the altitude of the North Star above the horizon.

In each case, the officer used the mariner's sextant to determine the north and south position of the ship on the earth, or, in other words, to find its latitude at the time the observation was taken.

With a well-made sextant, in experienced hands, the latitude of a ship can be determined by the sun and stars, with surprising accuracy, the margin of error not exceeding a mile or two. This information, plus that furnished by the ship's compass and chronometer, enables the captain to hold a true course, and, if necessary, go straight to any position radioed by a ship in distress.

Since finding the latitude of a ship at sea is the outstanding application of astronomy to everyday human affairs, everyone should know something about it. So this article will be devoted to the manner of making and using a simple sextant. The determination of longitude will be covered in a later article.

Before we start the job of making a rough cardboard sextant, we must understand why the sun and the North Star, as well as other heavenly bodies, can be used to determine north and south positions on the globe.

In order to illustrate the principle clearly, let us refer to our umbrella upon which star positions are marked and the rod of which represents the polar axis of the earth. The earth itself can be an old tennis ball, split in half, and placed around the umbrella rod, as shown in the illustration. The black band around the ball stands for the earth's equator.

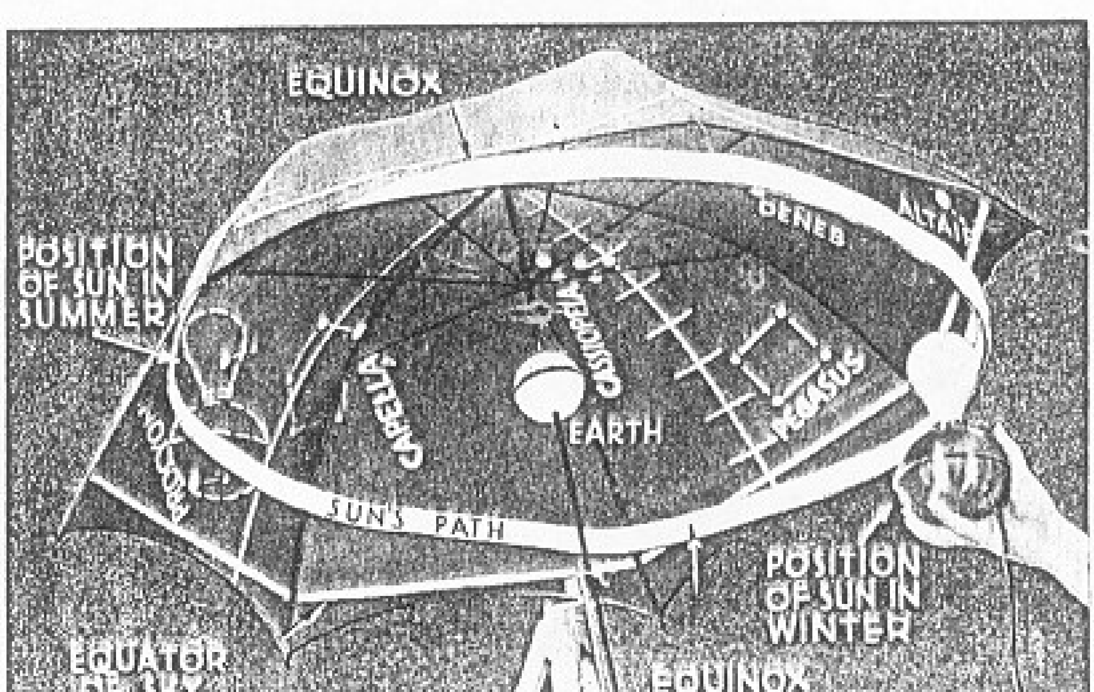
Since it is a little easier to catch on to the way the polestar is used in latitude observations, let us begin with Polaris rather than the sun.

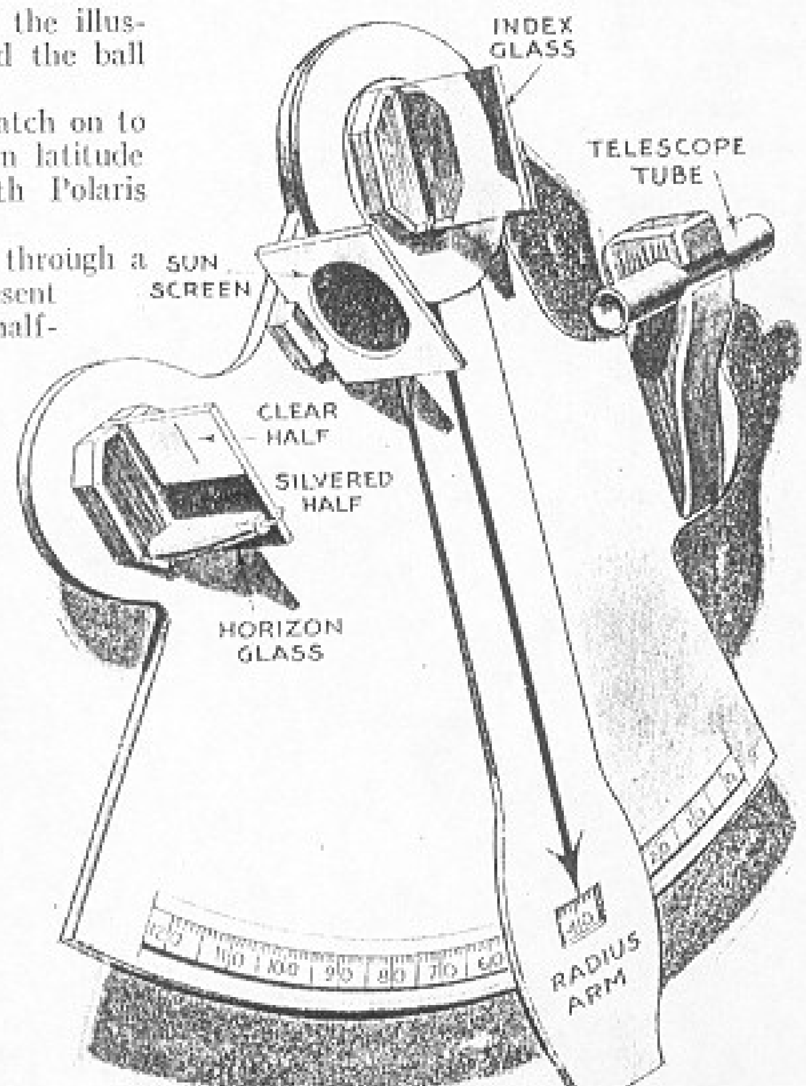
A pin is stuck into the ball through a little disk of cardboard to represent an observer on a ship that is halfway between the earth's pole and the equator. The edge of the disk represents the observer's horizon in every direction. Since the world's curvature is only a few inches to the mile, the comparatively small circle of sea visible from a ship can be regarded as approximately flat, as our disk is.

Since our earth is a mere grain of sand in comparison with the millions of miles to the polestar, any line parallel with the earth's axis will point just as close to the polestar as the line of the axis does. For our rough and ready purpose, let us say that our umbrella-rod axis points directly to the infinitely remote polestar. Accordingly, a line parallel to it from our observer will also indicate the star.

For the same reason, it follows that a plane drawn parallel to the earth's equator through the observer will cut the starry globe of the sky along the same circle as

UMBRELLA SOLVES LATITUDE PROBLEM. In the picture below, the earth's orbit around the sun is indicated by the cardboard hoop. The plane of the earth's equator and its prolongation among the stars is indicated by the black line on the ball and chalk line on umbrella, which is tilted in line with earth's axis





HOW YOUR SEXTANT WILL LOOK. This is how a homemade sextant looks when assembled. Note, sun is south of equator in winter and north of it in the summer

the plane of the earth's equator itself does. If you think of the earth as a grain of sand in stellar space, you will have no trouble in getting this idea.

With this point settled, it is easy to see how latitude is found from an observation of the polestar's height above the northern horizon.

It is plain that the observer's line of sight to the polestar makes a right angle with his line of sight to the equator of the sky. It is also apparent that his horizon is at right angles to the zenith, a point directly over his head.

Now cut two accurate quarter circles from a sheet of writing paper and a moment's experimenting with them will quickly show you how latitude is found. First label the edges of the quarter circles as shown in the drawing and then hold them up toward the light with their curves and points coinciding.

As you now hold the quarter circles against the light and rotate them upon each other around their common center, you will notice that the angle between the line to the polestar and the line to the horizon will always exactly equal the angle between the line to the zenith and the line to the equator. As the first angle is increased in size, the second increases with it, and vice versa.

You can now see that as soon as our observer has measured the angle of the polestar above his horizon, he has also measured the distance of his overhead point, or zenith, from the point where the plane of the earth's equator cuts the sky. This means that he has found his latitude, for latitude is simply his distance north or south of the equator.

Suppose our observer finds that the polestar is forty-five degrees above the horizon. Then he knows at once that his position is forty-five degrees north latitude.

If the sun crossed the sky every day in the exact plane of the earth's equator, a skipper could find his latitude from it almost exactly as he does from the polestar. After measuring with his sextant the height of the noon sun in degrees above the southern horizon, he would need only to subtract this from ninety degrees, the distance from his zenith to his southern horizon. The number of degrees remaining would be his latitude.

The sun, however, only crosses the sky in the plane of the equator on two days of the year—once in the spring, and again in the fall. On all other days, its path is at a constantly varying distance north or south of the equatorial plane. Accordingly, a skipper must correct his observation of the sun's height by the distance that the sun is north or south of the equatorial plane on that day. This difference is called the sun's "declination" and is given for every day in the year in the Nautical Almanacs published by all governments that have navies or mercantile shipping.

In summer, when the sun's declination is north of the equator, the correction must be *added* to the distance between the sun's position and the zenith, in order to obtain the latitude. In winter, when the sun's path runs south of the equator, the declination is *subtracted* from the distance between the sun's position and the zenith.

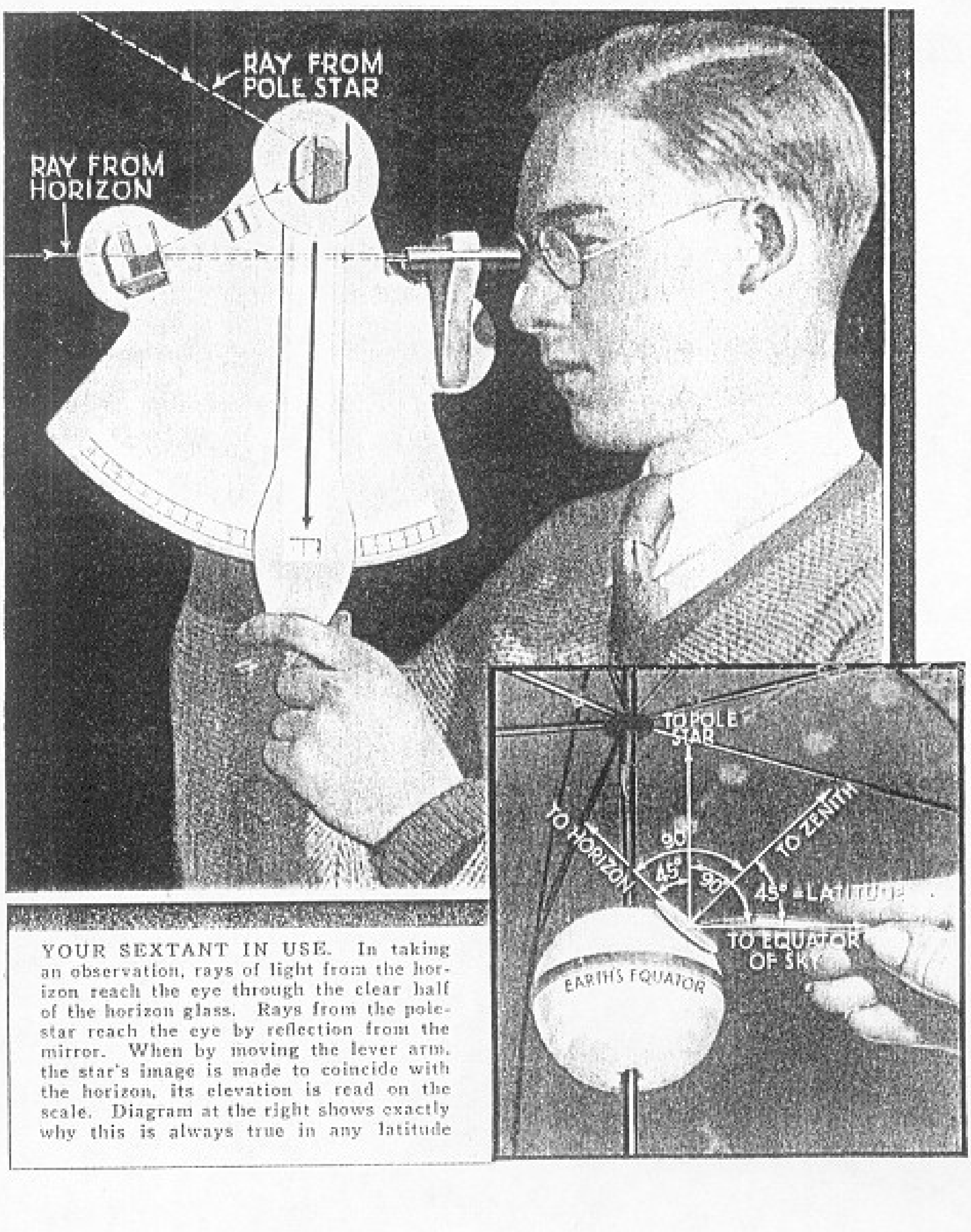
When you made your crossbow rule for measuring angles between stars in the sky (P.S.M., June, '33, p. 42) you were reinventing the device that was the great-grandfather of the modern sextant. Mariners once used the crossbow rule, or cross staff, for the purposes the sextant now fulfills with far greater accuracy.

The photo-diagrams and scale plan shown on the first page of this article, give all the measurements and arrangement of parts necessary to build a model sextant, with which you can find the approximate latitude of your home. You can do this by taking the altitude of the North Star or the sun. In employing the sun, observe it for a couple of minutes before noon. The sun's distance from the horizon will increase slowly until it is exactly on the meridian. After that it will decrease. The mariner's object, and yours, is to measure the sun's angular distance from the horizon when it is at its highest point.

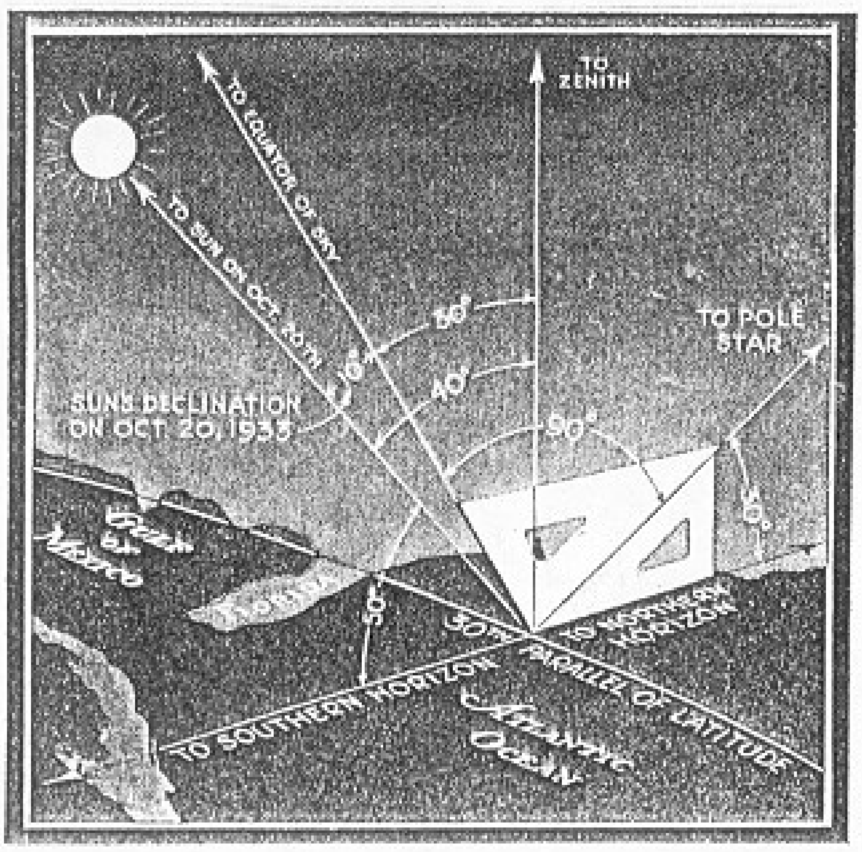
To do this, look at the horizon through the telescope tube on the sextant. Then move the radius by its handle until the sun comes into your field of view. Move the handle gradually as the sun ascends to the meridan, keeping the sun on the horizon line. When the sun ceases to rise, stop observing and read the figure from your sextant's scale.

When you have read this angle on the scale of your sextant, subtract the number of degrees from ninety. This gives the sun's zenith distance. To this add or subtract the sun's declination for that day, depending upon whether the sun is north or south of the equatorial plane.

If you make your observation on Sept. 23 or 24, you can neglect the sun's declination as it is then crossing the equator,



YOUR SEXTANT IN USE. In taking an observation, rays of light from the horizon reach the eye through the clear half of the horizon glass. Rays from the polestar reach the eye by reflection from the mirror. When by moving the lever arm, the star's image is made to coincide with the horizon, its elevation is read on the scale. Diagram at the right shows exactly why this is always true in any latitude



SHIP'S CAPTAIN FINDS LATITUDE

If a ship's officer wanted to find his latitude off northern Florida on next October 20, he would shoot the sun at noon and find it fifty degrees above the horizon, or as the diagram shows, forty degrees from the zenith. As the declination of the sun on that date will be ten degrees, the officer subtracts to get latitude

SUN'S DECLINATION

Distance North or South of Equator at Weekly Intervals

+ *sign means Sun is North of Equator*

— " " " " *South* " "

Sept.	1	+8 degrees	53	minutes
Sept.	8	+5 "	57	"
Sept.	15	+3 "	17	"
Sept.	22	+0 "	35	"
Sept.	29	—2 "	8	"
Oct.	6	—4 "	51	"
Oct.	13	—7 "	31	"
Oct.	20	—10 "	6	"
Oct.	27	—12 "	33	"

and the correction is less than one-sixth of a degree.

In observing the sun, you will of course need some sort of a dark screen to protect your eyes from the glare. I made a satisfactory screen by fastening eight thicknesses of green cellophane together between small cardboard masks, and attaching the screen to the sextant in the path of the sun's rays reflected from the index mirror to the horizon mirror. You can, however, use a piece of glass smoked in a candle flame, and protected by another plain glass fastened over it.

The sextant's construction and principle of operation are made sufficiently plain in the illustrations. It is necessary only to add a word of caution. Be sure to reinforce the cardboard frame so that it will remain flat, or build it from laminated wood. Also, take care that the two mirrors are perpendicular to the frame and parallel to each other when the arrow points to zero on your sextant's scale of angles.

It is better to make the degree scale on a separate piece of Bristol board and attach it after the mirrors are actually parallel. It is easy to prove that they are in this condition by sighting at a distant telephone pole or steeple, and moving the radius arm gently until the two images of the object blend into one. Then attach your scale with glue, and your sextant will be correctly adjusted for altitude observations.

The horizon glass is easily prepared by scratching off the silver from its upper half. The index mirror is left fully silvered.

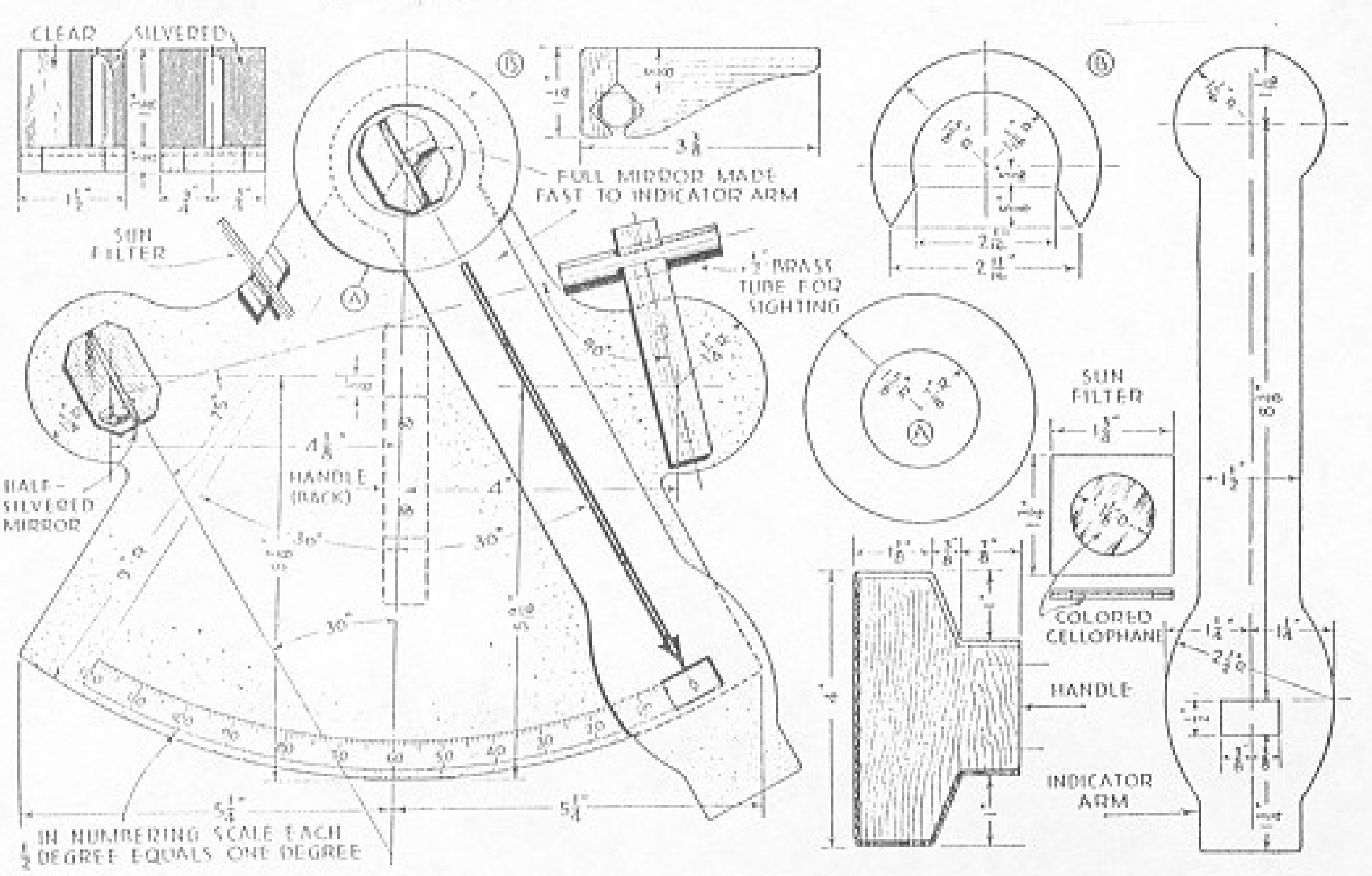
After placing the circular head of the radius arm in its cardboard socket, a pin should be run through the center and bent over on the back to act as a secure bearing. If you use three-ply wood, the pin may become a small wood screw.

The telescope is merely a small piece of brass tubing to direct your eye at the proper angle. In a professional sextant, this telescope, of course, contains lenses.

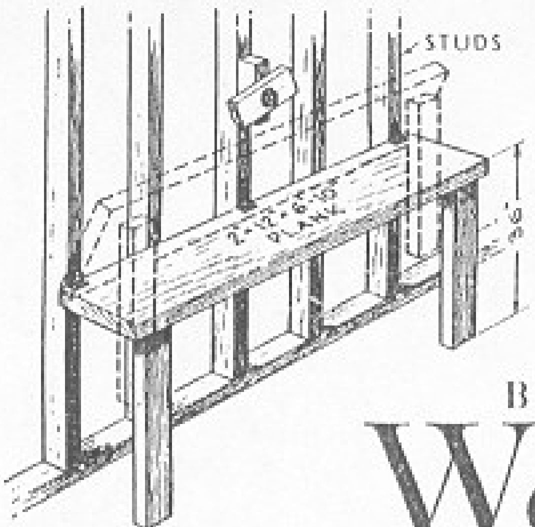
With care in constructing your model, you can determine your latitude with fair accuracy from the polestar or sun. However, unless this is done over water, you should select a location where there are no hills on the horizon.

IT IS needless to say that this article makes no attempt to enter into the fine points of the astronomy of navigation. As a matter of fact, the polestar is about two degrees distant from the pole, and the aim has been merely to make the principles plain by making use of them in practice, and thus give you the thrill of finding your approximate position upon the earth's surface with no other aid than the sun and stars.

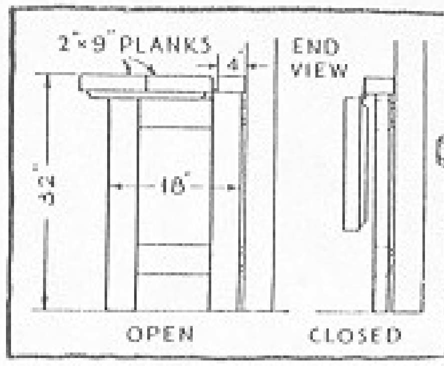
The next article will show how to make a simple equatorial telescope mounting, and a simple telescope of medium power. The method through which astronomers find stars by their right ascension and declination will also be illustrated by experiments with the equatorial telescope mounting. Also, we shall complete the astronomy of navigation by learning how longitude is determined.

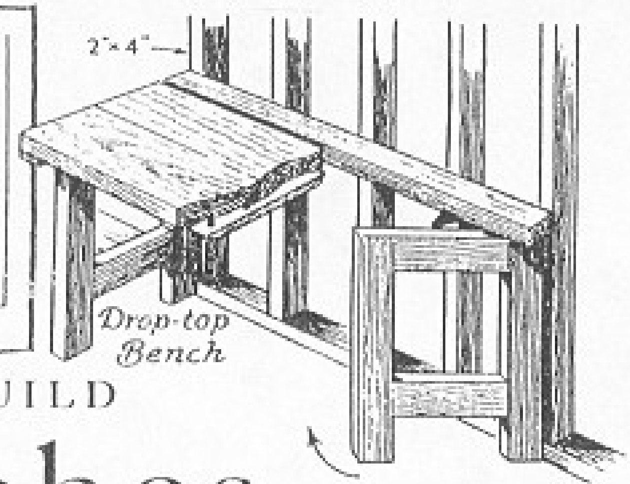


Drawing of parts and dimension necessary in making your own sextant



Folding Bench for Narrow Garage

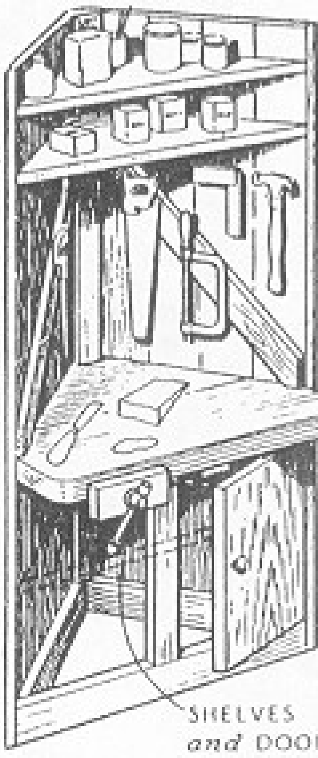




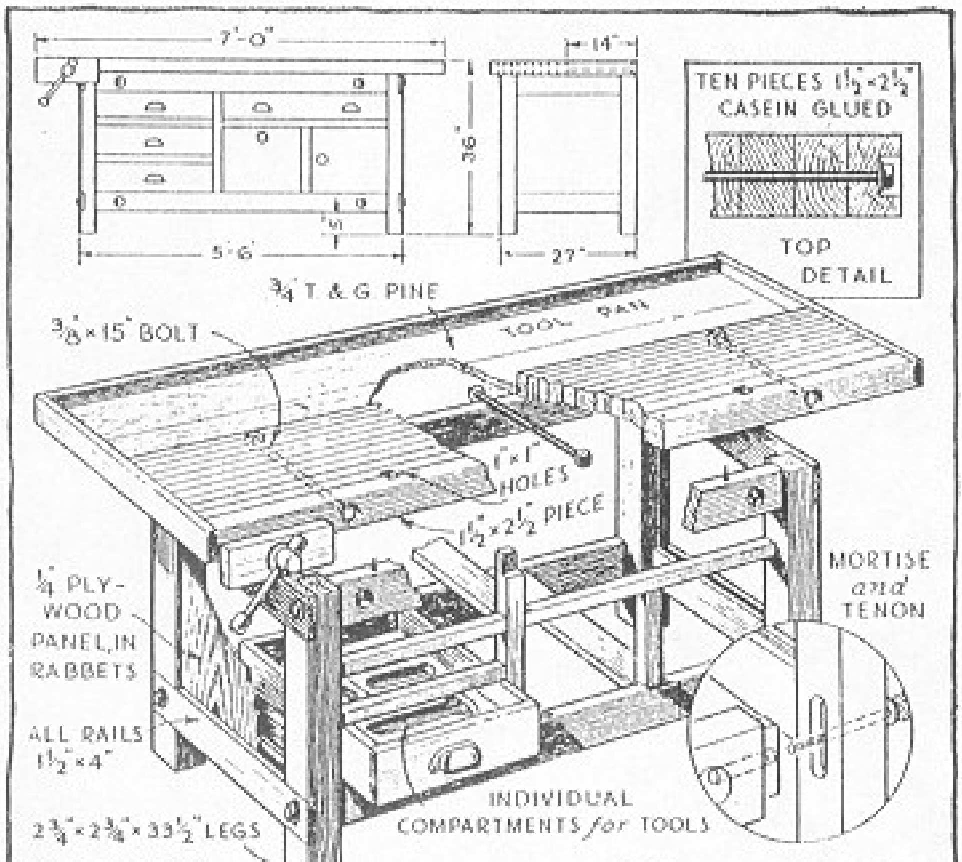
BETTER WAYS TO BUILD

Workbenches

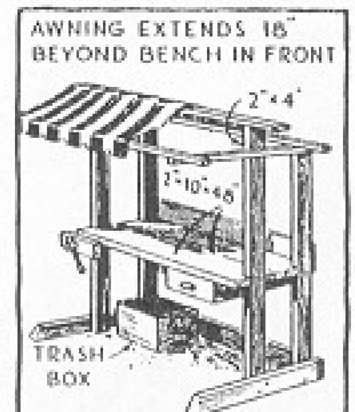
Popular Science Monthly — February 1936



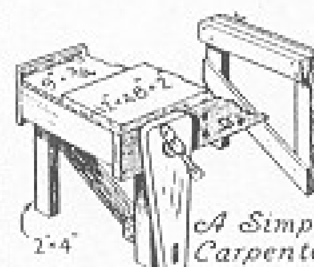
Portable Corner Work Cabinet for House Use



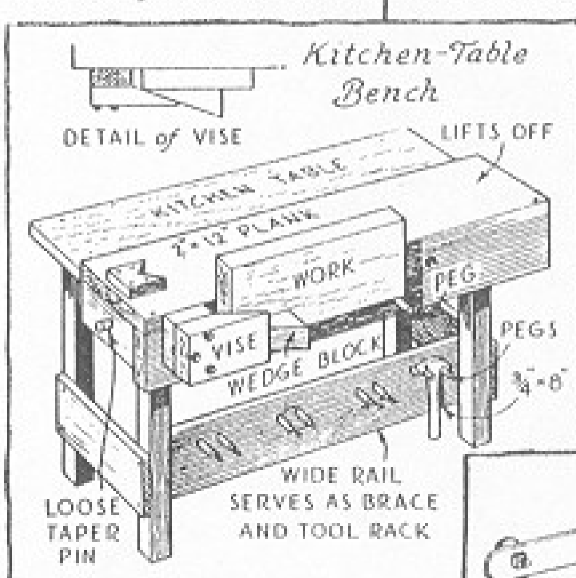
Sturdy General Purpose Bench



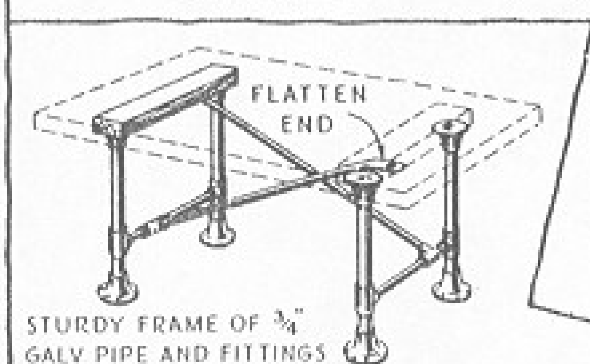
For Unused Space Alongside Driveway

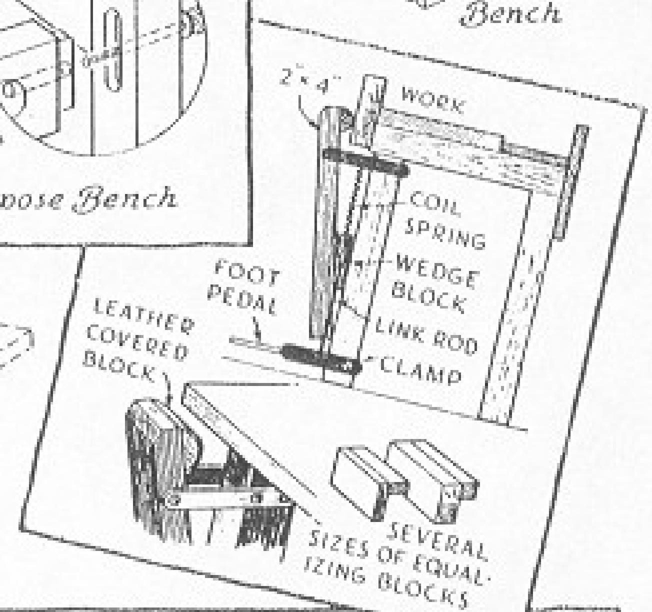


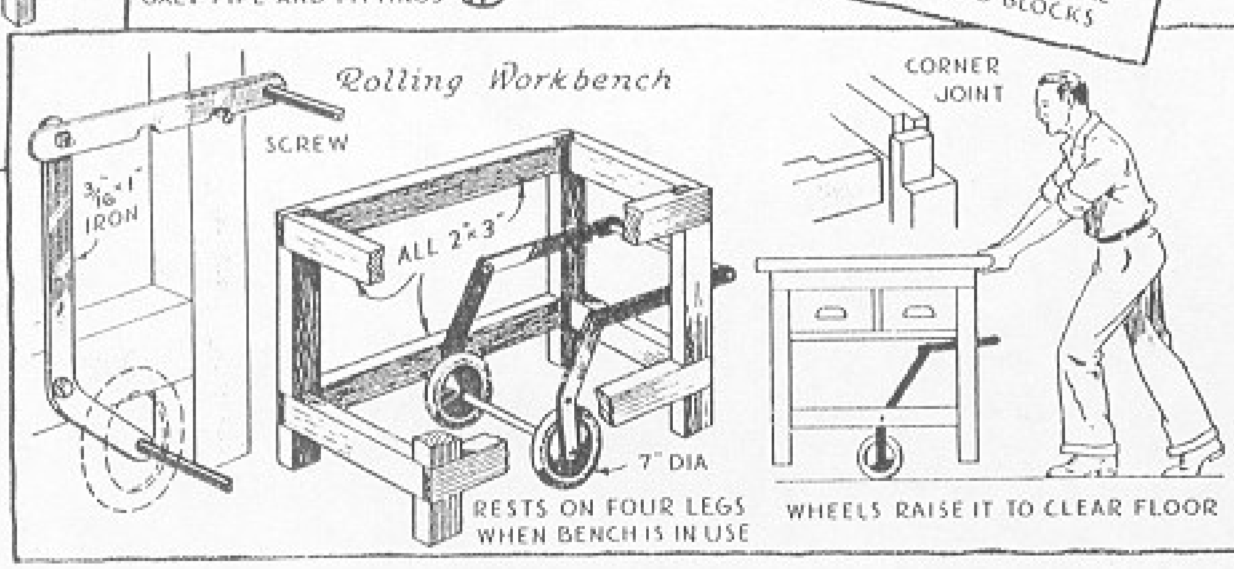
A Simple Carpenter Bench



Kitchen-Table Bench

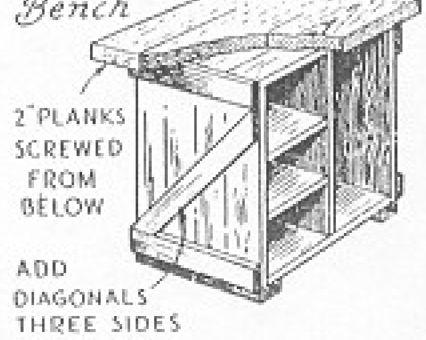


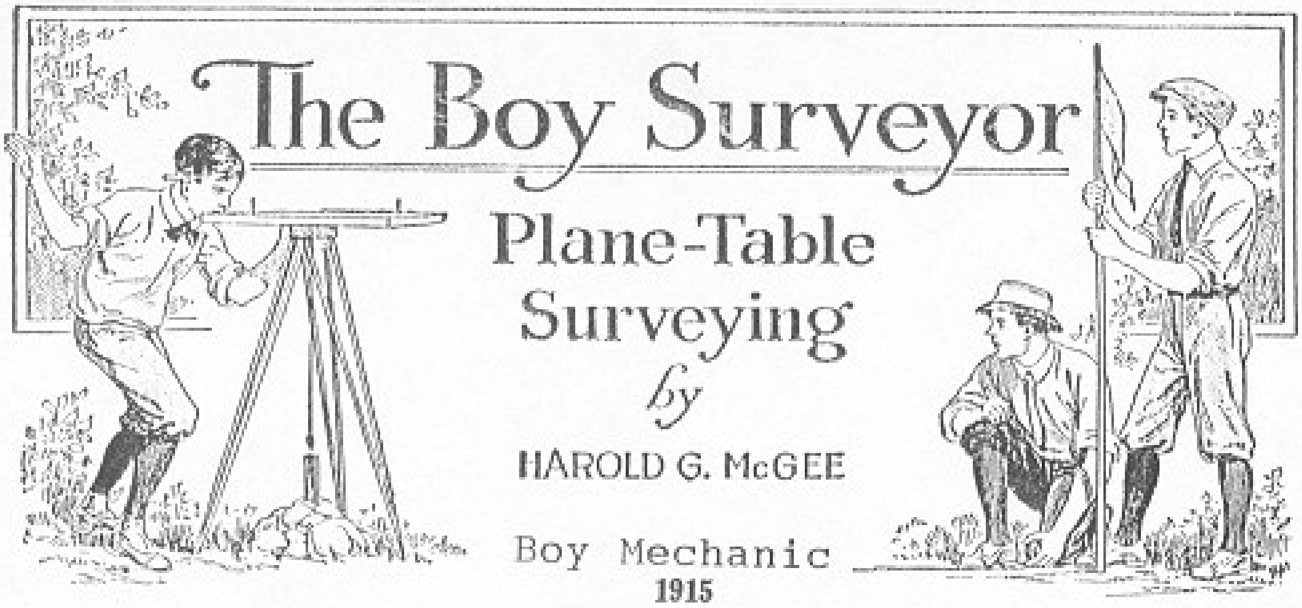




Rolling Workbench

Packing-Box Bench





The Boy Surveyor

Plane-Table Surveying

by

HAROLD G. McGEE

Boy Mechanic
1915

[In the training of a boy for a trade or profession there is none so profitable for outdoor work as that of a surveyor. This article sets forth how to accomplish surveying and the making of simple maps with the use of commonplace tools that any boy can make.—Editor.]

Surveying and map making have always been two of the most interesting things a civil engineer has had to do. And, like George Washington, many of the men we look up to today as successes in different lines worked as surveyors in their younger days. Surveying takes one out of doors, and is apt to lead him into the unknown and unexplored byways of the earth.

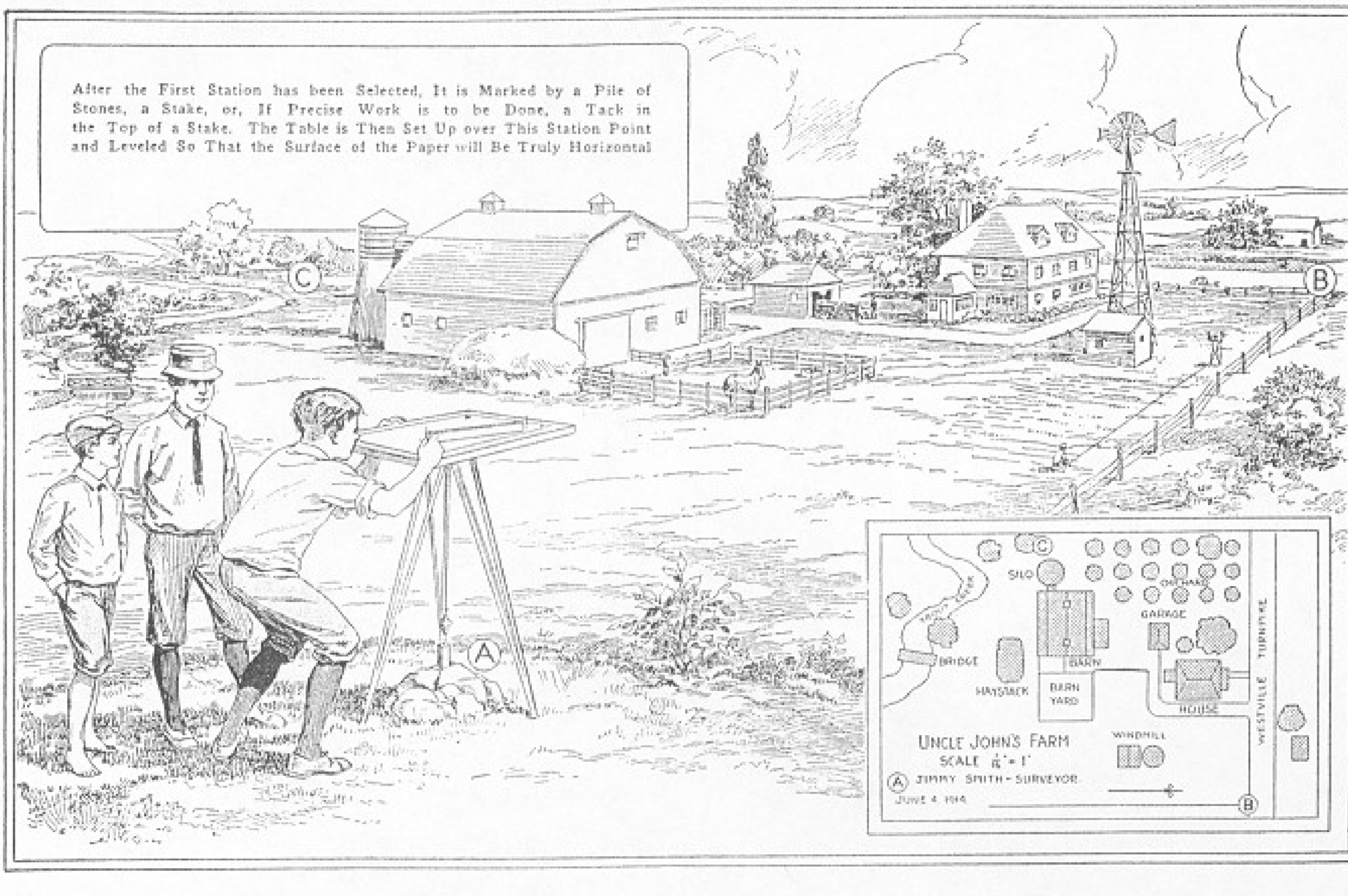
Though modern surveyors often use precise and expensive instruments, creditable surveys can be made with simple and inexpensive apparatus. Of such apparatus, two of the simplest are the plane table and the camera. Since one must know the principles of plane-table surveying before he can do camera surveying, this paper will describe the plane table alone, leaving the camera for another chapter.

A plane table is simply a drawing board mounted on a tripod so that it can be set up and worked upon in the field. One kind of plane table, which is used in the army for reconnaissance, does not even have a tripod; it is simply strapped to the arm of the man who is using it.

Plane-table maps vary greatly in scale and the area they represent. Landscape artists' plans may show only single city lots, while some topographic maps cover hundreds of square miles on a single sheet. For maps of a small farm, a park, or a residence block in the city, a plane table is almost ideal, since plane-table maps are made with rather simple apparatus and do not require much actual measuring on the ground. Most objects are located without ever going to them, or even sending a rodman to them.

Besides the plane table itself and a sheet of paper, only a small carpenter's level, a tape to measure a few distances with, and some spikes for markers, a hard lead pencil, a ruler, and a few needles are absolutely necessary for this sort of a map.

To start a plane-table map, a station must first be selected from which as many as possible of the objects to be located on the finished map can be seen. Ordinarily, the objects one would locate are corners of buildings, fence corners, intersections of roads, corners of lots, banks of streams, possibly trees,



After the First Station has been Selected, It is Marked by a Pile of Stones, a Stake, or, If Precise Work is to be Done, a Tack in the Top of a Stake. The Table is Then Set Up over This Station Point and Leveled So That the Surface of the Paper will Be Truly Horizontal

and section and quarter-section corners in the country. A railroad, a lake, a mountain, or anything which forms a noticeable landmark in any particular locality, ought to be on the map. In mapping a territory which has never been surveyed before, the first surveyor may name the hills and streams.

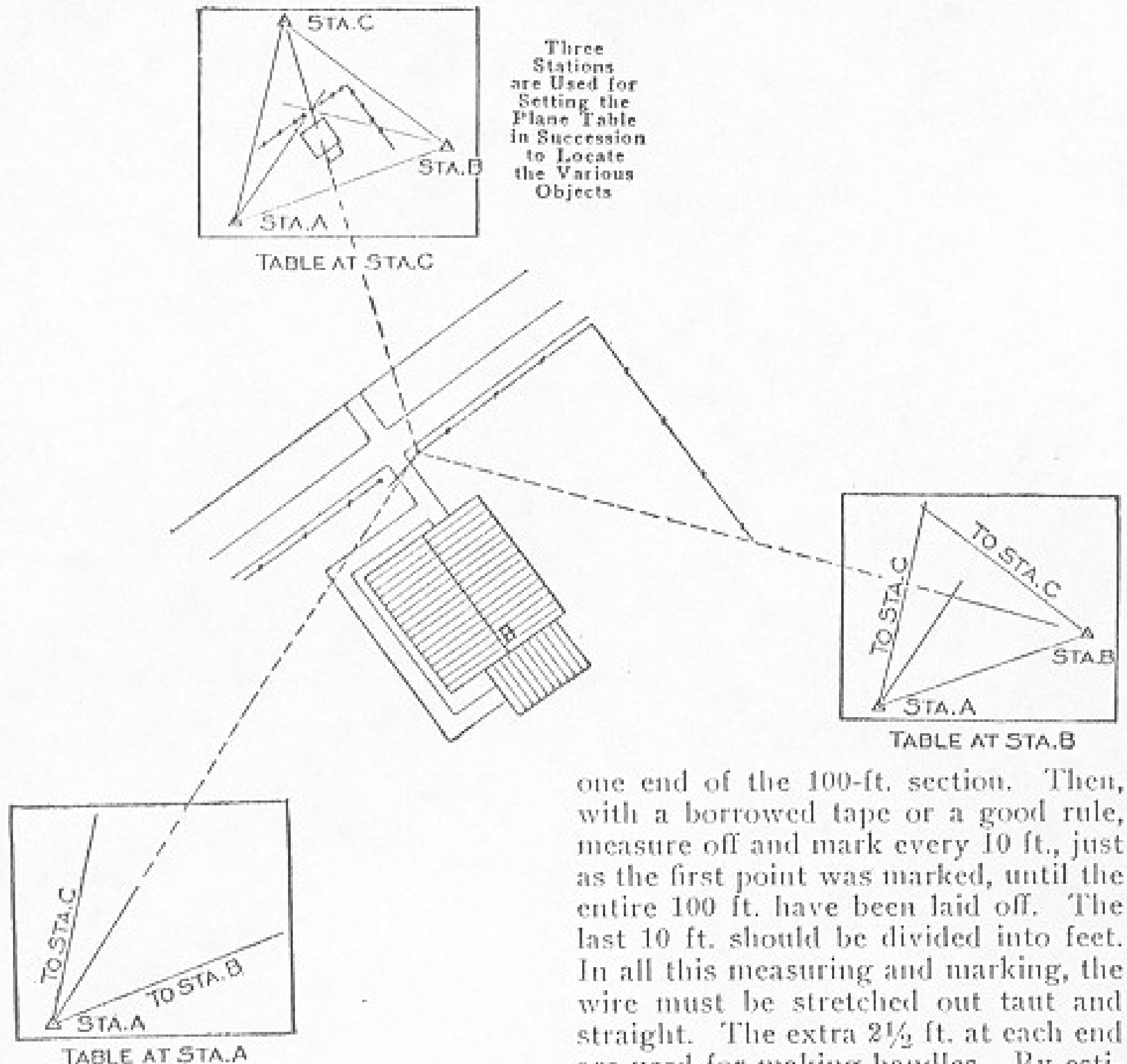
After the first station has been selected, it is marked by a pile of stones, a stake, or, if precise work is to be done, a tack in the top of a stake. The table is then set up over this station point and leveled so that the surface of the paper will be truly horizontal. Generally, too, the board is "oriented," that is, placed so that two of its edges point north and south and two east and west. It is then clamped so that it will not move while working on it.

To begin the map, a point on the table is chosen to represent the station on the ground over which the tab'e is set. This point is marked by sticking a fine needle into the paper, vertically. A small triangle should be drawn around the needle hole in the paper and labeled "Sta. A," so that it will not be lost in the maze of points which will soon cover the sheet. By sighting past this needle toward some object which is wanted on the map, like the corner of a house, its direction can be marked by setting another needle on the far side of the table, in line with the first and the given object. Then, if a ruler or straightedge be placed against these two needles and a fine line drawn connecting them, this line will show the exact direction of the object from Sta. A. All the other objects which are wanted on the finished map and can be seen from Sta. A are located by direction in the same way.

The first points to have their direction thus marked ought to be the next stations to be occupied. If all the objects to be located can be seen from three stations, or even two of three stations, three stations will be sufficient. The distance to one of them from Sta. A should be carefully measured and laid off to scale along its direction line on the map. Its place on the map should be marked exactly as the first station was, substituting B for A. It is wise, after every few sights at other objects, to take a sight along the line AB to make sure that the board has not turned. A good map is impossible if the board twists.

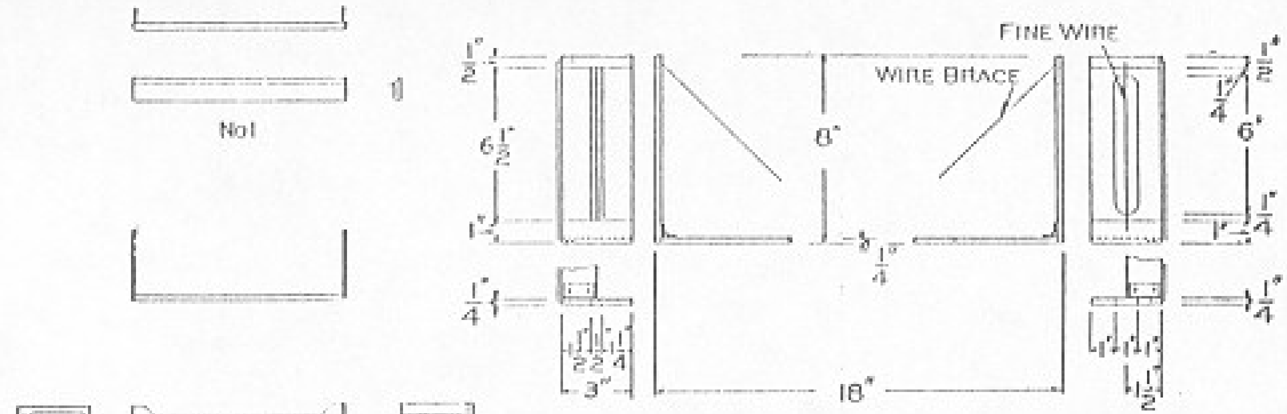
To measure the distance between stations, a 50 or 100-ft. tape, or some accurate substitute, is necessary. An ordinary piece of iron telegraph wire, 105 ft. long, is a good substitute. A point, about 2½ ft. from one end, is marked with a little lump of solder. A chisel dent in this solder will mark one end of the 100-ft. section. Then, with a borrowed tape or a good rule, measure off and mark every 10 ft., just as the first point was marked, until the entire 100 ft. have been laid off. The last 10 ft. should be divided into feet. In all this measuring and marking, the wire must be stretched out taut and straight. The extra 2½ ft. at each end are used for making handles. By estimating the tenths of a foot, measurements can be made with such a tape, or "chain," as an old-time surveyor might call it, just as accurately as they can be laid off on the map.

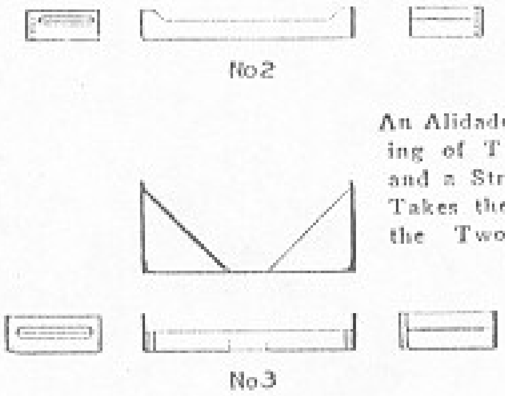
Two men are required for measuring, or "chaining," a head and a rear chainman. The rear chainman holds the 100-ft. end of the tape on the station point, while the head chainman takes his end forward toward the station to which they are measuring. When he has gone nearly the length of the tape, the rear chainman calls "halt." The head chainman stops and draws the tape up tight, while the rear chainman holds his division end on the starting point. Then the head chainman sticks a spike into the ground to



Three Stations are Used for Setting the Plane Table in Succession to Locate the Various Objects

Just a Few Weeks After George Washington's Sixteenth Birthday, in 1748, Lord Fairfax, Owner of a Large Estate in Virginia, Took Him into His Employ as a Surveyor





An Alidade, Consisting of Two Sights and a Straightedge, Takes the Place of the Two Needles

mark the place where his division end comes, calls out "stuck," and starts on toward the object point.

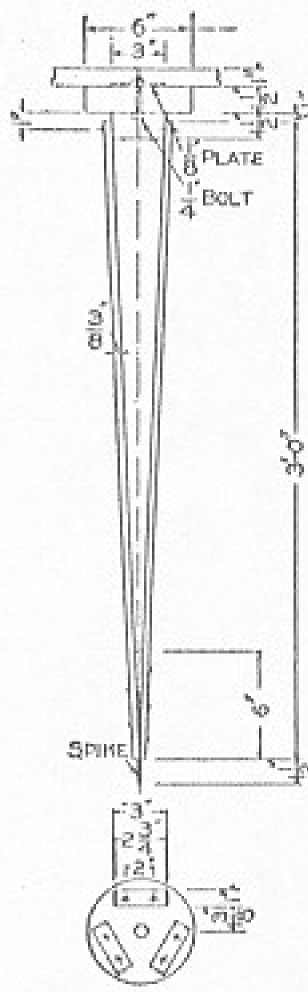
Large spikes make good marking pins, especially if they have little red or white strips of cloth tied to them. Surveyors use 11 markers. One is stuck into the ground at the starting point and is carried forward by the rear chainman, who also picks up the markers at each 100-ft. point as soon as the head chainman calls "stuck." In this way, the number of markers which the rear chainman has in his hand is always the same as the number of hundreds of feet which the last set marker is from the starting point.

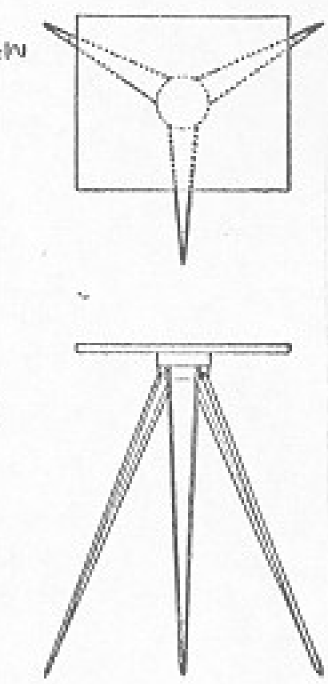
In measuring between two points, care must be taken to draw the tape out taut and straight, its two ends must be level with each other, and it must be exactly in line with the two points between which the measurement is being made. In measuring downhill, one end may have to be held up high, and the point on the ground where the end division would come, found by dropping a stone from the place where it is in the air and watching for the spot where the rock strikes the ground. A surer way to do this is to hold a plumb-bob string on the last division and carefully let the bob down until it touches the ground. A rod with a red or white flag on it ought to be placed at or just beyond the point to which the measurement is to be made so that the rear chainman can easily line in the head chainman. The latter, before he places his marker, looks back to the rear chainman to be told whether or not he is "on line" with the object point. If he is not, and ought to go to the rear chainman's right to get "on," the latter holds out his right arm and the head chainman moves accordingly. When he reaches the right point, the rear chainman signals "all right" by holding out both of his arms and then dropping them to his side; the marker is stuck, and both move up a hundred feet and repeat the process.

After all the points possible have been located from Sta. A, and the direction lines labeled lightly in pencil so that they can be distinguished when the board has been removed from the station, the plane table is picked up and carried to Sta. B. Here it is again set up, leveled, and oriented by making the direction of the line AB on the paper exactly the same as that of the line from Sta. A to Sta. B on the ground. This is done by placing needles at points A and B on the table and then turning the board until the two needles and Sta. A are in line. Sights are taken on the same objects which were "shot" at Sta. A, and to objects which were not visible from Sta. A. The intersection of the lines of sight toward a given object from A and from B marks the location on the paper of that object. If the two ends of a straight fence have been located in this way, a straight line joining the points will show the location of the fence on the map. By exactly similar methods, every other object is located on the paper.

In order to avoid errors, it is an excellent scheme to locate three stations near the outside edges of the area to be mapped, and locate all objects possible by sights from each of the three stations. If, instead of all three crossing each other at a point, the lines of sight from the three stations form a triangle, something is wrong. If the triangle is very small, it may be safe to use its center as the correct point; if not, the work must be repeated and checked. Locating even a few points by this method may prevent some bad blunders. The three stations ought to form as nearly as possible, an equilateral triangle; and the distances between all of them should be measured and laid out accurately on the plane table.

There are two ways in which the map may be finished, inked, or traced. By drawing in the "culture," that is, the things built by man, like the houses, the fences, the roads, and the railroads, in black ink; the topography, that is, the hills and valleys, in brown; the water, in blue, and then erasing all the construction lines, a very neat map can be made. Another way is to get some "onion-skin" paper, or some tracing cloth, tack it over the penciled map, and trace the lines right through, using black India ink. This tracing can be blueprinted, just as a photographic film. A plain, neat title, describing location of map; who made it and when; the scale used; why it was made, if it was made for a special pur-





A Rigid Tripod is Made of Strips for Legs, Which are Fastened to a Large Top

pose, and the direction of the north point, ought to be on every map. The topographic sheets published by the United States Geological Survey are good samples to follow. They have been published for a great many places all over the country, and single copies can be obtained by sending 10 cents to the Director, United States Geological Survey, Washington, D. C.

Plane tables are almost as easily made as they are bought. If there is no old drawing board around the house, a new bread board from the ten-cent store will serve. For ordinary work, a table which is 15 or 20 in. square will do very well. The board must be mounted on a tripod so that it will be rigid while it is being worked upon and yet can be unclamped and oriented. A brass plate, with a hole in it and a

From an Original Drawing of a Survey of Mount Vernon, Made by George Washington at the Age of 14

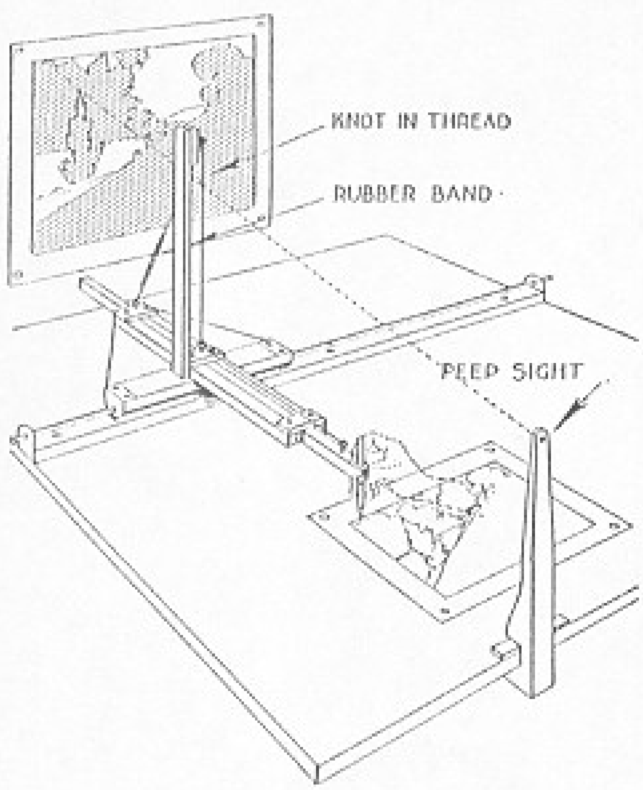
nut soldered over the hole, screwed to the bottom of the board will permit the board and tripod to be bolted together in good shape. Another method, which is not nearly as good, is to drill a hole clear through the board, countersink it on top for a bolt head, and bolt the board and tripod head directly together. With the brass plate and nut, the camera tripod can be pressed into service if a nut of the proper size has been used. The camera tripod is, however, apt to be wabbly with a drawing board on top; a much more satisfactory tripod can be built as shown in the accompanying drawings. Each leg is made of two strips of wood, 3/4 by 3/8 in. and 3 ft. long. These strips are screwed together at their lower ends, gripping a spike between them which will prevent the legs from slipping on the ground. The tops of the strips are spread apart and screwed to the opposite ends of an oak or maple cleat. This cleat is, in turn, screwed to the under side of the circular tripod head.

In place of the two needles and the ruler described for marking the line of sight, most plane-table men use an alidade, which is a combination of two sights and a straightedge. A very simple alidade may be made by mounting two needles on a ruler. The straight edge of the ruler is placed against the needle which marks the station at which the plane table is set up. Then, by swinging the ruler around this needle until its two sighting needles come in line with some object, the line of sight can be drawn directly on the paper along the edge of the ruler. A surveyor in India once made an alidade out of a piece of straightedge and two sights made of native coins hammered out by a native blacksmith. Two pieces of cigar box, one with a fine vertical saw slit in it, and the other with a vertical slot and a piece of fine wire or silk thread stretched down the center, glued to a well planed, straight, flat piece of wood, make a fine alidade. A careful worker may be able to put his sights on hinges so that they will fold down when not in use.

More than anything else, map making rewards care and accuracy, and shows up slipshod workmanship. If the pencils are sharp, the lines fine, and if the work is checked often, beautiful maps can be made with very simple apparatus.

Machine for Sketching Pictures

An ordinary drawing board, with the attachments shown, provides an easy way to sketch pictures, even if



This Machine Aids a Person in Drawing the True Outline of a Picture

one is not proficient in this line of work. It is only necessary to look through the sight and move the pencil about so that the knot in the thread follows the outline of the landscape or object being drawn.

The size of the machine depends on the one building it, but a fair-sized drawing board is sufficient for the beginner. A strip of wood is fastened to the board, near one edge, which has a metal piece on each end, fastened to the under side and bent up over the end to form an extension for the rod to support the moving parts. The strip of wood should be 3/4 in. wide and 1/4 in. thick, and the sliding arm, holding the pencil, 1/2 in. wide and 1/4 in. thick. A like strip, but much shorter than the one fastened to the board, is also fitted with metal pieces in an inverted position so the projections will be downward. A 3/16-in. rod is run through holes in the metal pieces of the strips at both ends, and soldered to those on the strip fastened to the board. This will make a hinged joint, as well as one that will allow the upper strip to slide horizontally.

Centrally located on the upper strip are two more strips, fastened with screws at right angles to the former, with a space between them of 1/2 in. for the sliding center piece holding the pencil. These pieces are further braced with a wire at the back, and crosspieces are screwed both on top and under side, to make a rigid guide for the sliding pencil holder. An upright is fastened to the side of one of these pieces over the center of the upper horizontal sliding piece for a screw eye to hold the thread. Another screw eye is turned into the crosspiece just under the one on the support, so that the thread will run perpendicularly between them. Two more screw eyes are fastened, one into the upper surface of the rear crosspiece, and the other in the end of the pencil holder, near the pencil. By connecting these screw eyes, as shown, with a thread, having a rubber band fastened in the rear end and a knot tied in it near the screw eye in the upper end of the vertical stick, a means for following the outlines of the picture is provided.

A vertical stick is fastened to the front edge of the board by means of a notch and wedge. In the upper end of this stick a very small hole is bored for a sight, similar to a peep sight on a rifle.

To use the machine, set the board on a table, or tripod, and level it up in front of the object to be drawn. Look through the sight at the front of the board and move the pencil about to keep the knot of the thread on the outlines of the picture to be drawn.—Contributed by Wm. C. Coppess, Union City, Ind.

¶White marks on waxed surfaces may be removed by rubbing lightly with a soft rag moistened in alcohol, after which rub with raw linseed oil.

¶A walnut filler is made of 3 lb. burnt Turkey umber, 1 lb. of burnt Italian sienna, both ground in oil, then mixed to a paste with 1 qt. of turpentine and 1 pt. of japan drier.

THE BOY SURVEYOR
Camera Surveying
by Harold G. McGee

[This article explains the preparation of the camera for taking the pictures at each of the three stations, after which the plates are developed, printed and kept until a convenient time may be had for plotting the ground. The succeeding article will give in detail the making of the map from the photographs.—Editor.]

CAMERA surveying is simply plane-table surveying in which the landscape has been photographically picked up and carried indoors. It has the enormous advantage that one can obtain a record of the utmost fidelity in a small fraction of the time taken to do the field work of even a sketchy plane-table survey, and that plotting can be done in the comfort and with the conveniences of a drafting room. When the hours one can work are short or the periods of clear, dry weather are few and far between, a camera is an ideal surveying instrument. It sees and records with the click of the shutter.

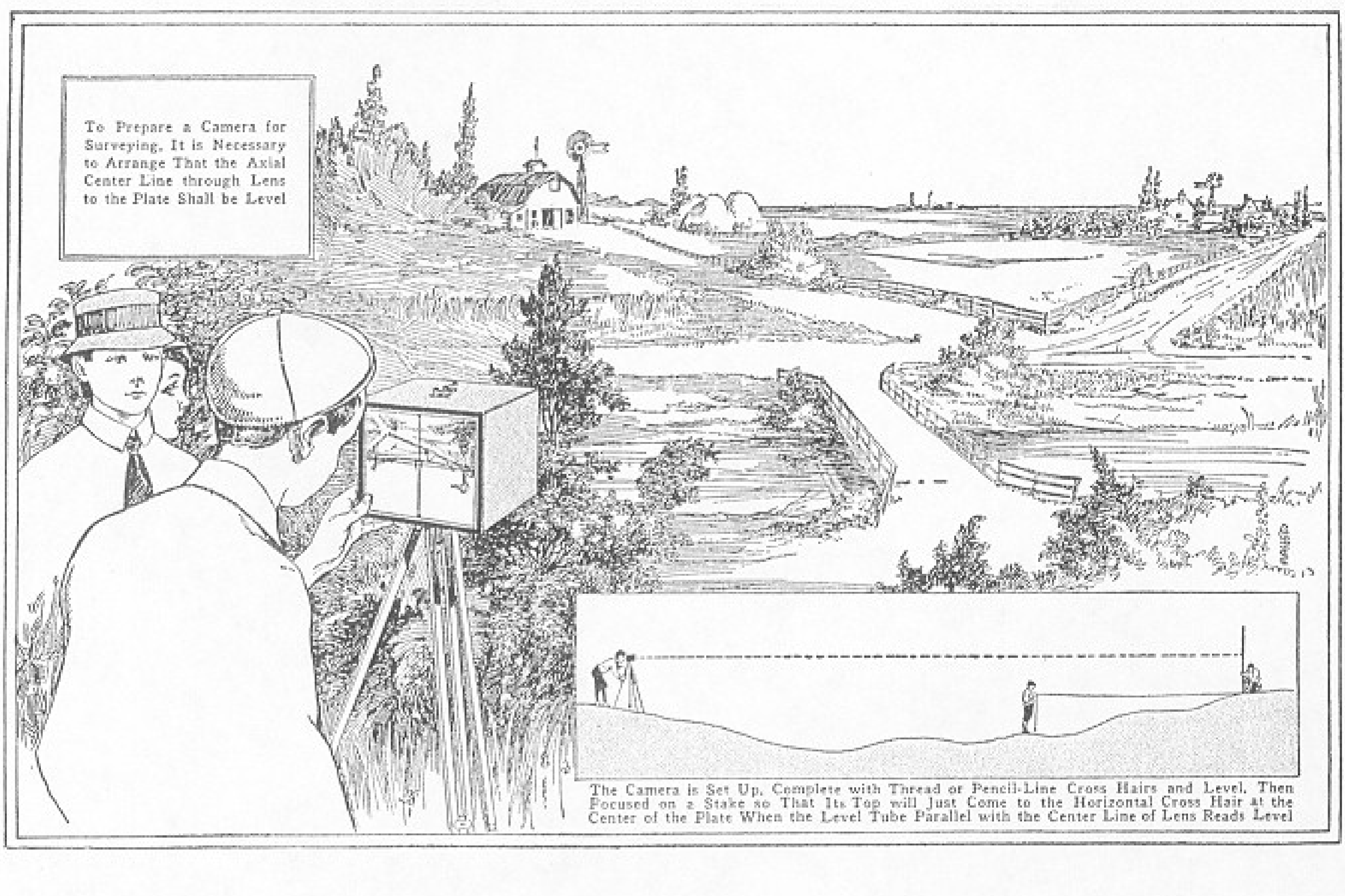
Surveying by camera was proposed early in the infant days of photography; but not until the eighties were photographic surveys commenced in earnest. With the extensive surveys of the Canadian Rockies by the Canadian government within the past decade and the topographic surveys of the Alps, the camera has very recently indeed achieved the dignity of being known as a "sure-enough" surveying instrument. Even today, few surveyors have ever used photography for making surveys, even though for mountain topography or any survey which includes a large number of distinctive, inaccessible landmarks, the camera asks no odds of either the plane table or the stadia transit.

A camera survey taken of the summer cottage or the camping ground will be a source of great delight while it is being plotted up of winter evenings. There is something weird in watching each tent and dock slip into

must be fitted with a spirit level and some arrangement for cross hairs. A T-shaped level on the bed or the box, carefully adjusted, will show when the its place with naught but a pair of dividers and a few pictures to do the trick. And when the map is done, there are all the data to tell just where a tennis court can go or a walk ought to be built.

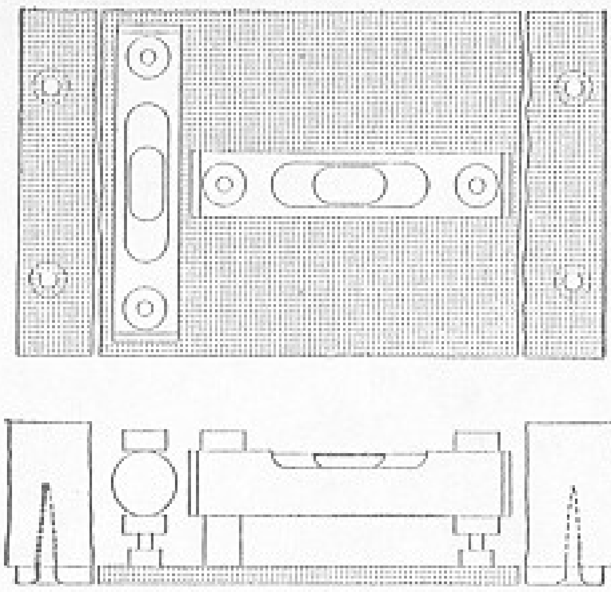
In making surveys, a plate camera will do more accurate work than will a film camera; and a fixed focus is a big help in plotting. In spite of the special and expensive instruments which have been designed solely for surveying work, a little ingenuity on the part of the owner of most any kind of a camera, be it big or little, film or plate, box or folding, will do wonders toward producing good results.

To be used for surveying, a camera plate is vertical and when the perpendicular line from the center of the plate to the center of the lens is horizontal. Actual cross hairs in the camera are not as good as four tiny points of V's, one projecting from the middle of each side, top, and bottom of the camera box, just in front of the plate holder. How the level is to be adjusted so that a line between the upper and lower points will be truly vertical, and one through the die-side points truly horizontal and on a level with the center of the lens when the bubbles are in the



To Prepare a Camera for Surveying, It is Necessary to Arrange That the Axial Center Line through Lens to the Plate Shall be Level

The Camera is Set Up, Complete with Thread or Pencil-Line Cross Hairs and Level, Then Focused on a Stake so That Its Top will Just Come to the Horizontal Cross Hair at the Center of the Plate When the Level Tube Parallel with the Center Line of Lens Reads Level



A T-Shaped Level with Adjusting Nuts is Located on the Camera Box, or on the Bed of the Folding Camera

center of the spirit level, will be described later.

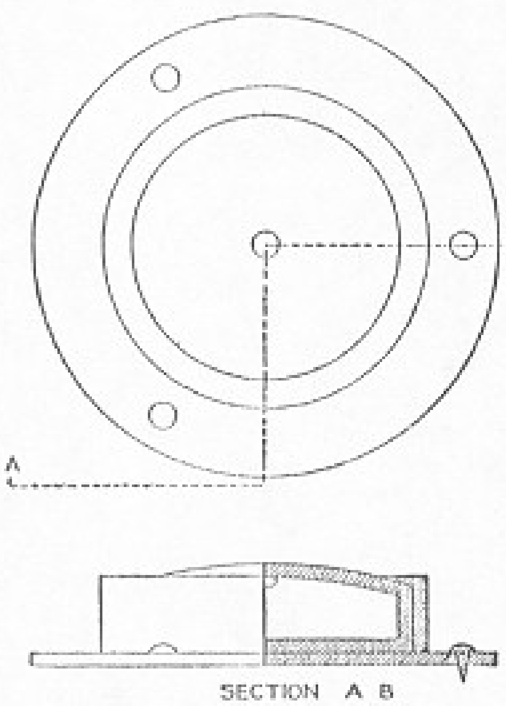
Camera Preparation

To prepare a camera for surveying, it is necessary to arrange that the axial center line through the lens to the plate shall be level, and that the location of the horizontal and vertical center lines shall be indicated on the plate. A spirit level is the best solution of the first problem, and indicated center points of the second.

The spirit level preferably may be of the T-form, with two level tubes, or of the "universal" circular form, with which some hand cameras are equipped. However, ordinary hand-camera levels are generally too rough and difficult of adjustment to insure accurate work. On a view camera, the level may be conveniently located on the bed which carries the lens board. If it is screwed to the under side of the arms it will be convenient for use and out of the way. The bed is likewise a good location for the level on a folding hand camera, while the top of the box is about the only possible location with a box-type instrument.

The cross hairs or center-line indicators should be placed on the back of the camera, just in front of the plate. If indicators are used, fine-thread cross hairs or pencil lines drawn on the ground glass must be used temporarily for making adjustments. Generally, the two cross hairs will divide the plate vertically and horizontally into four equal parts and the hairs or indicators will join the center point of the sides and top and bottom of the opening immediately in front of the plate. But it is essential that the cross hairs have their intersection in a line perpendicular to the plate and passing through the center of the lens. Thus in a camera in which the lens is not placed in the center of the plate, or in which the rising and sliding front has placed the lens off center, either or both of the cross hairs may be off center with regard to the plate.

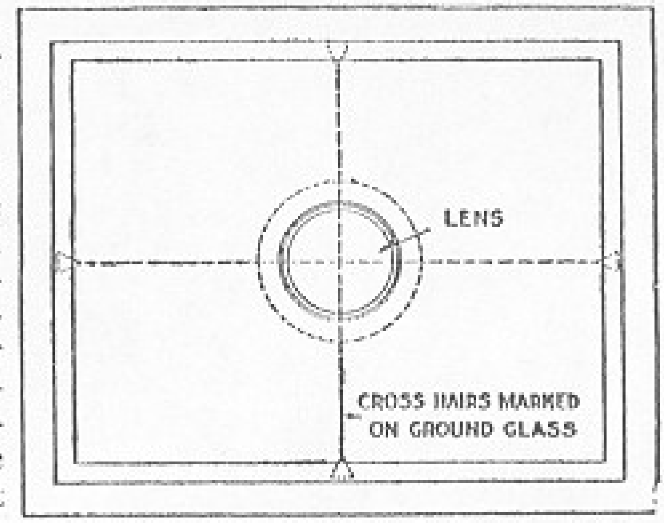
After the cross-hair indicators and the level have been attached to the camera, adjustments are necessary. Surveyors distinguish between permanent and temporary adjustments, permanent adjustments being those for which the instrument maker is responsible, and temporary adjustments being those which can be and are made in the field. The principal permanent or maker's adjustments of the surveying camera are those which insure the center line through the lens, or axial center line, or line of collimation, being perpendicular to the plate, the intersection of the cross hairs being on this line, and that the cross hairs themselves are mutually perpendicular. Temporary or field adjustments must be so made that one tube of the spirit



The Ordinary Round Level may be Used, but It Is Not so Good as the T-Level

level shall be parallel with the axial center line through the lens and the other parallel with the horizontal cross hair.

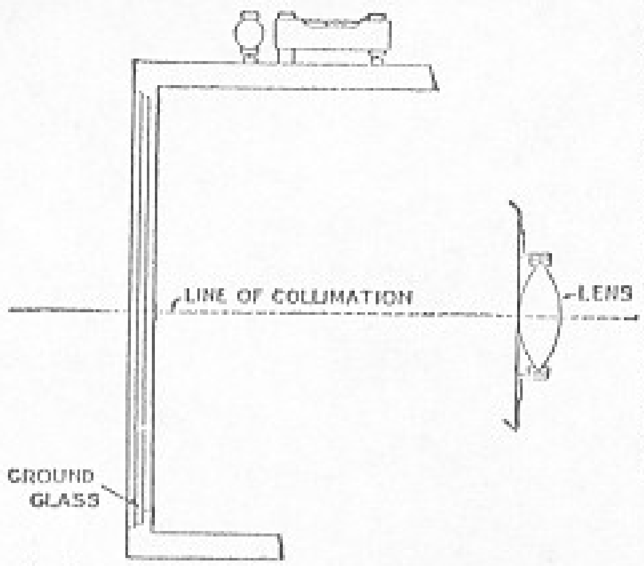
The first field adjustment is made in the following manner. The camera is set up, complete with thread or pencil-line cross hairs and level, and focused on a stake whose top shall just come to the horizontal cross hair at the center of the plate, when the level tube parallel with the center line of the lens reads level. This stake may be driven to the required elevation or a rod may be held on it and the point where, in the image on the ground glass, it is intersected by the cross hair marked with pencil on the rod as it is held vertically on the stake. The distance to this stake is measured from the camera and another similar stake set at the same elevation by the same method, but in an op-



The Cross Hairs or Center-Line Indicators should be Placed on the Back of the Camera

posite direction and at the same distance from the camera. The two stakes or the mark on the vertical rod which is held on these stakes in turn will be level with each other, though they may not be level with the camera. The camera is then moved to a point very much closer to one stake than to the other and again leveled. The vertical distance from one stake-top or mark on the rod is measured and the camera then focused on the second stake. If the level is actually in adjustment, the distance from the second stake top or mark will be exactly the same as it was on the first. If not, the difference, or "error," is found between the two vertical distances from the cross hair to the two stake tops. Half this error is corrected by raising or lowering one end of the level tube by means of the threaded nuts which are placed on it for the purpose. The whole process is then repeated until the vertical distances from the horizontal cross hair at the center to the two level stakes, one close to and one distant from the camera, are identical. The axial center line of the lens, or the line of collimation, is then in adjustment with the level. All that remains is to make the horizontal cross hair parallel with the cross level.

This is done by using one marked stake. The camera is leveled as far as the "fore-and-aft" level is concerned and the horizontal cross-hair point at the center marked on the stake. The camera is then swung round until the stake just shows on one edge of the ground glass, the fore-and-aft or longitudinal level being checked to make sure its bubble is still in the center. Then the bubble in the cross or transverse level tube is brought to the center by means of the threaded adjusting nuts, and the camera is thrown hard over so that the stake appears along the opposite edge of the plate. This time, the bubble of the longitudinal level being kept

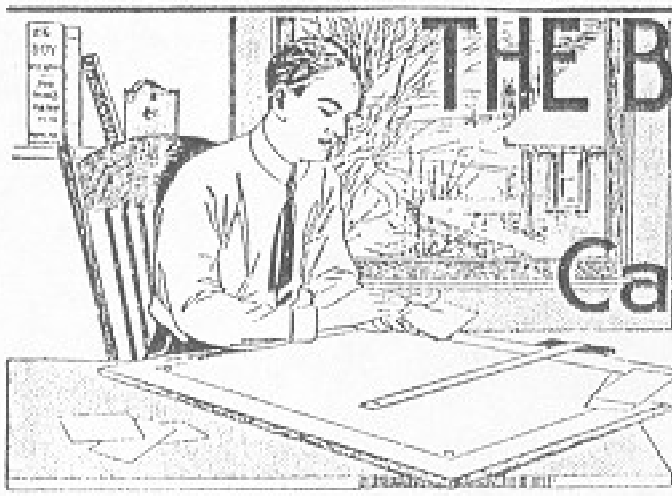


The Maker's Adjustments Should Insure the Line of Collimation being Perpendicular to the Plate

in the center, half the error introduced by turning from one edge to the other is corrected. All of the adjustments are then rechecked, and if they are found correct the instrument is ready for use. If a circular level be used, the method of adjustment is exactly the same, the swing of the bubble along the axis of the camera and transverse to it being used to determine the longitudinal and transverse adjustments. Slips of paper may be used for lifting one side in place of the adjustment nuts of the T-level.

A leveling head or ball-and-socket joint on the top of the tripod will be found of material aid in leveling the instrument.

No great mechanical genius is necessary to prepare a camera for or to make a successful camera survey. But if a boy have not patience and an infinite desire for accuracy, camera surveying, or indeed any sort of surveying, will be a source of neither pleasure, satisfaction, nor profit.



THE BOY SURVEYOR

Plotting a Camera Survey

by Harold G. McGee

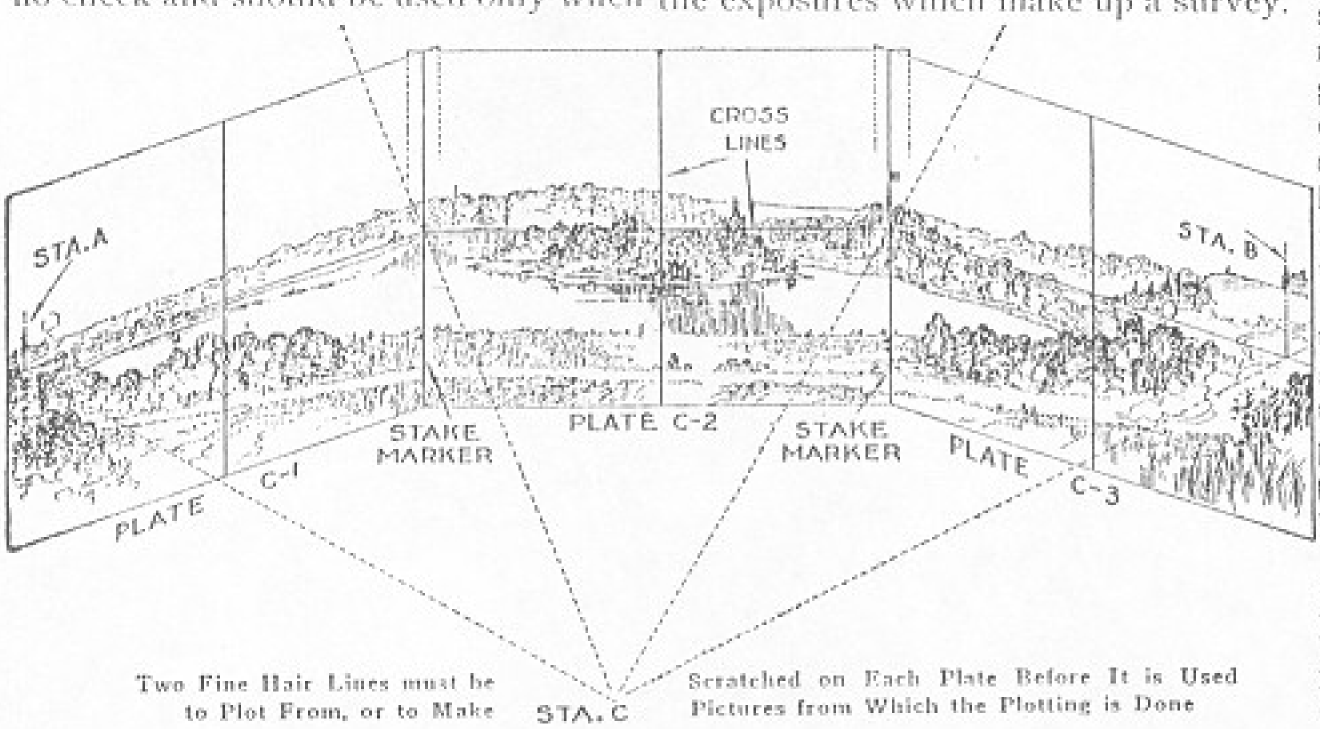
[The camera records pictures that can be taken in camp or on a vacation trip and kept until more leisure may be had in winter for plotting the ground.—Editor.]

A PREVIOUSLY measured base triangle with "stations" at each corner is necessary for making a camera survey, just as it is for the plane-table survey. It is preferable to have each of the three sides measured independently, though if one side has been accurately chained, the other two may be less satisfactorily determined by the use of the plane table. If the camera has a fixed focus, it is possible to make an entire survey from the two ends of a single base line; but this method has no check and should be used only when and where the triangle method is impossible. With an adjustable focus, it will rarely give good results.

Once the triangle has been laid out, the fieldwork is very simple. The camera is set up at one station, carefully leveled, and then a series of pictures is taken, each single plate overlapping the last so as to form a panorama of the area to be mapped. The focus of the lens must not be changed during a series, and plotting is facilitated by keeping the focus constant during all the exposures which make up a survey. To secure good depth of focus, a small stop is generally used, since it is necessary to use a tripod to keep the camera level. If contours are to be drawn, the height of the lens above the ground at the station should be measured and recorded. After a series has been taken at each station, the fieldwork is complete. It is an excellent plan to keep a record of the plate numbers, and the order in which and the station from which the exposures were made, so that the 10 or 12 plates which a small survey will comprise may not get hopelessly mixed up. If the camera is turned each time to the right, clockwise, and the plates are numbered A-1, A-2, B-4, etc., indicating by A-1, for example, the leftmost plate taken at Sta. A; by A-2, the plate just to the right of A-1, just as II is to the right of I on the clock dial, and by B-4, the fourth to the right taken at Sta. B, there ought to be no difficulty in identifying the plates after the exact details of the ground are forgotten.

While the pictures are being taken, "flags" of white wood or with white-cloth streamers tied to them must be stuck in the ground or held at the other stations in order that their exact location can be readily and certainly found on the plates. A few distinctive stakes, some with one and some with two or three strips of cloth tied to them, placed at important points on the ground will help immensely in the location of knolls and shore lines.

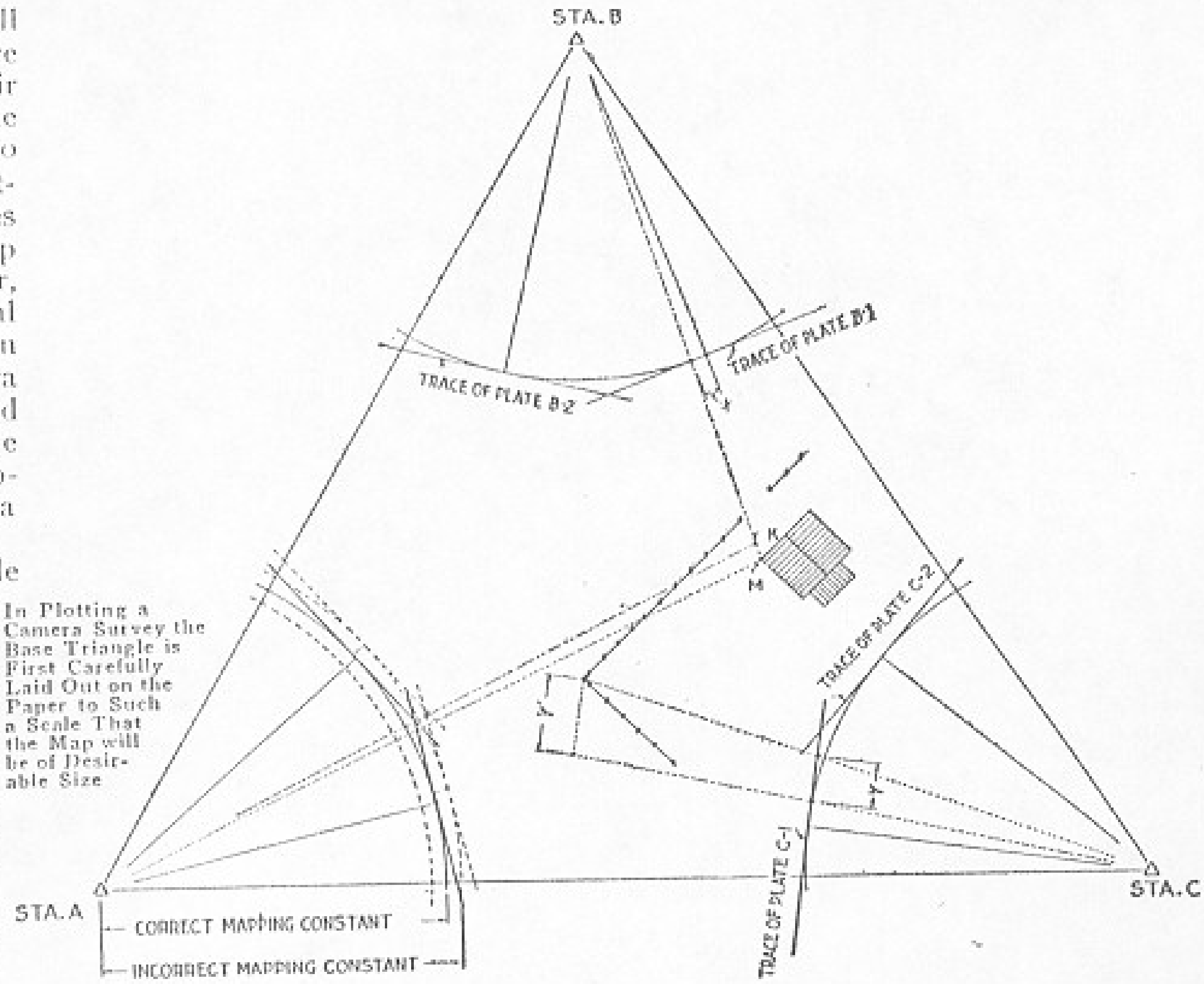
In plotting a camera survey, either the original plates, the prints, or enlargements may be used. The plates are the most accurate if a corrected lens has been used; and the enlarge-



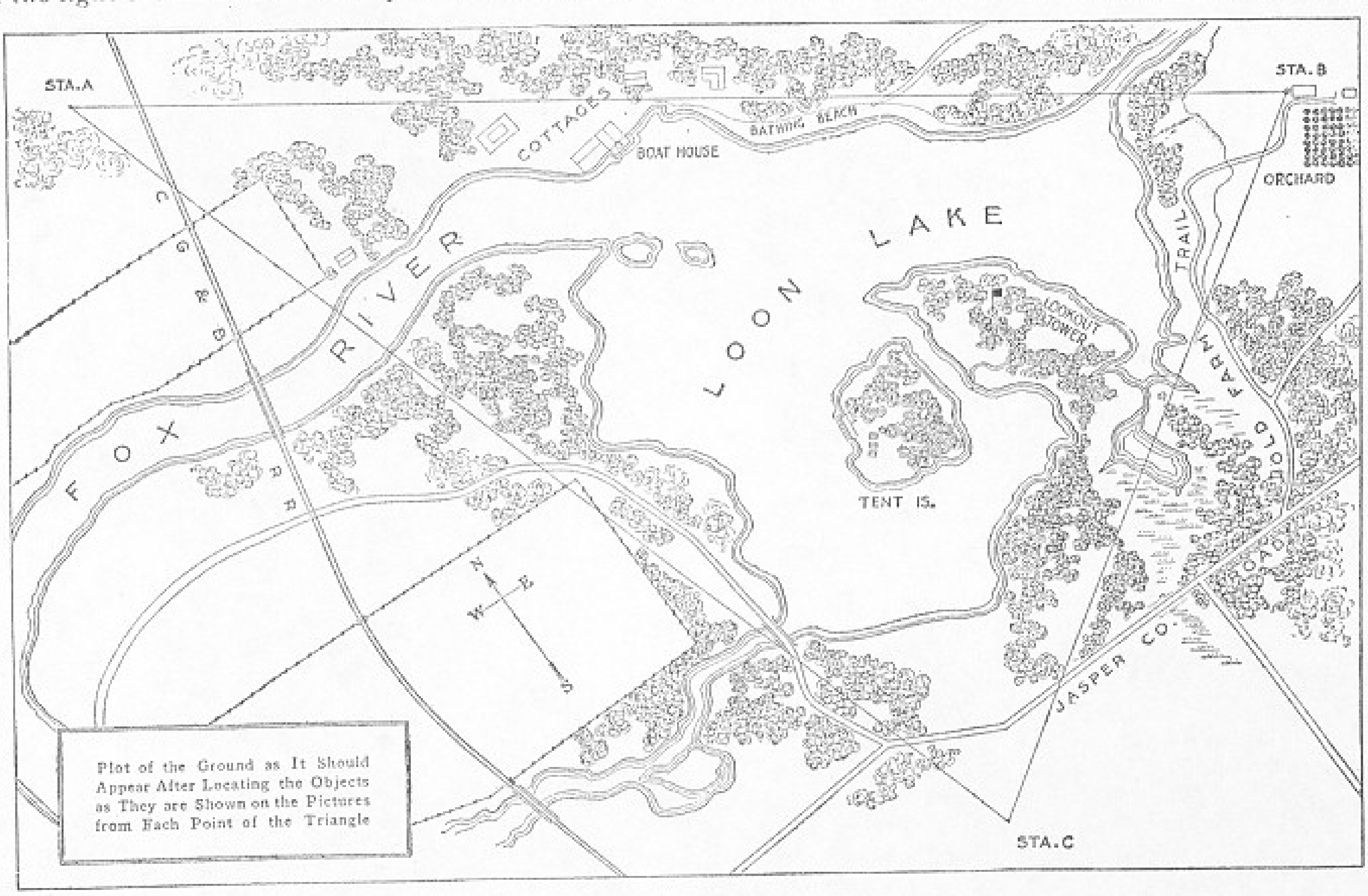
Two Fine Hair Lines must be Scratched on Each Plate Before It is Used to Plot From, or to Make Pictures from Which the Plotting is Done

ments made back through the lens will be best if the images on the plates are distorted. In any case, two fine hair lines must be scratched on each plate before it is used to plot from, or to make the prints from which the plotting is to be done. One of these lines should connect the points at the top and bottom of the plate, and the other, the points at the sides. The vertical line divides the objects which were on the right of the center of the camera from those that were on the left, and the horizontal line connecting the points on the sides separates the objects that were above the camera from those that were below.

If the survey has been made with a lens that does not cover the plate fully or that has considerable uncorrected aberration, causing distorted shapes near the edges and corners of the picture, results can be materially improved by plotting from enlargements. In making the enlargements, the back of the camera should be removed and the light should be allowed to pass through the plate and the lens in the reverse order and direction of that in which it passed when the negative was made. In this way, the errors which were made by the lens originally will be straightened out, and the resulting enlargements will be free from distortion. To make successful enlargements for surveying work, the easel on which the bromide paper is



In Plotting a Camera Survey the Base Triangle is First Carefully Laid Out on the Paper to Such a Scale That the Map will be of Desirable Size



Plot of the Ground as It Should Appear After Locating the Objects as They are Shown on the Pictures from Each Point of the Triangle

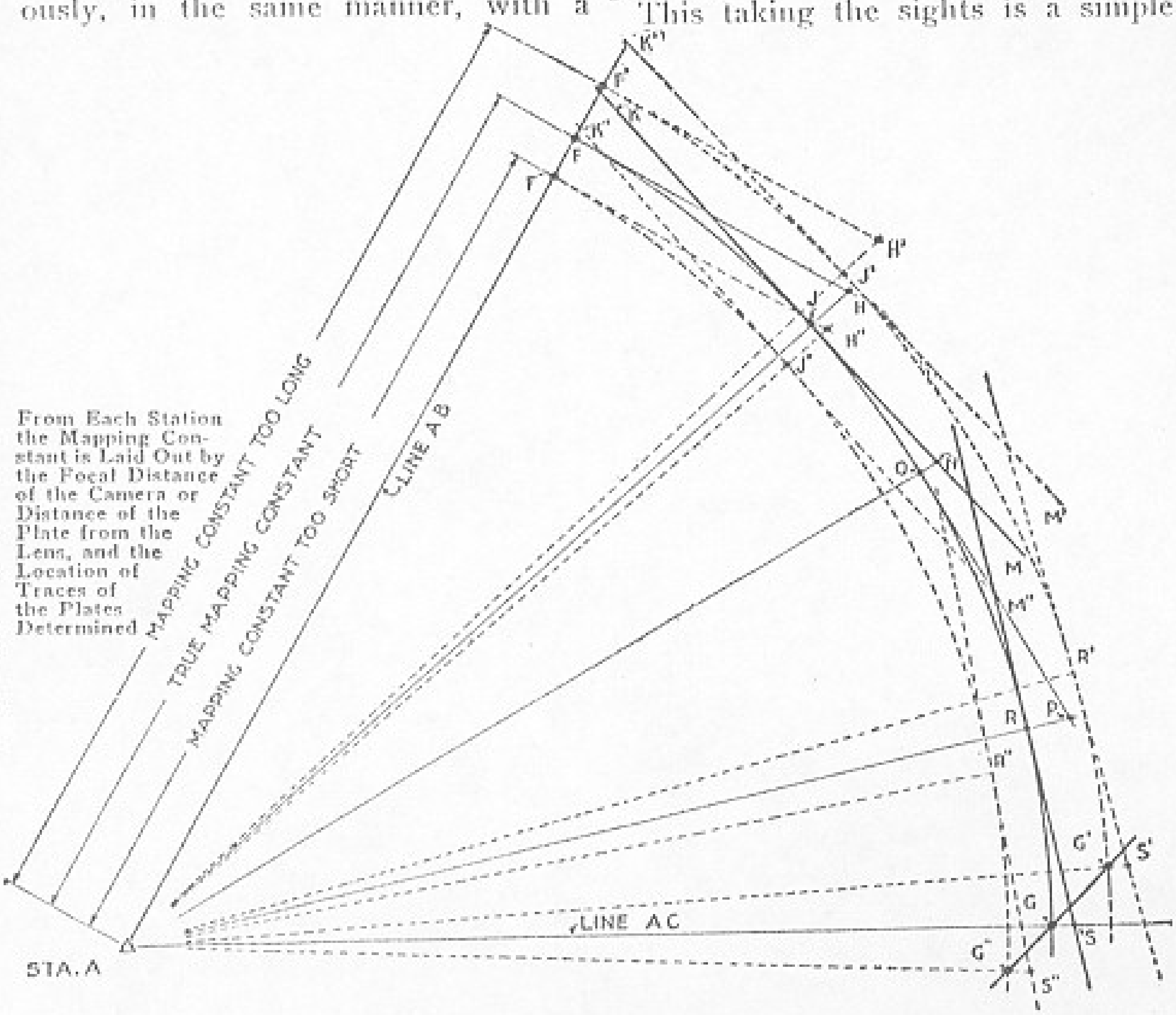
tacked must be square with the camera, and the paper itself should be flat and smooth. It is just as necessary to keep the easel at a constant distance from the camera during the enlarging as it was to keep the same focus while the original negatives were being made.

In plotting a camera survey the base triangle is first carefully laid out on the paper to such a scale that the map will be of a desirable size. With the apex of the triangle representing Sta. A, say, as a center, a circle is drawn with a radius as nearly equal as possible to the distance between the optical center of the lens and the plate when the picture was taken. Ordinarily this will be the focal length of the lens; but if the camera was not focused most sharply on an object a great distance off, the radius may be greater. This radius is called the "mapping constant." When an approximate distance for the mapping constant has been determined by measurements on the camera or by knowing the focal length of the lens, the circle, or rather the arc, FG between the two lines to stations B and C, is drawn. The plates taken at Sta. A, and ranged around this circle on the outside and just touching it, will show the landscape exactly as seen from A.

In the accompanying diagram showing the method of determining the mapping constant and of locating the traces of the plates, the letters F, G, H, J, P, R and S designate points referring to the true mapping constant, and the construction necessary to locate the traces of the plates. The primed letters F′, F″, G′, G″, etc., are used to show similar points where the trial mapping constant is either too long or too short. The following description refers equally to the construction necessary with true or trial-mapping constants.

Next, a line FH is drawn perpendicular to the line AB of the triangle at the point F where the arc intersects it. On this line is laid off, in the proper direction, a distance equal to the distance on the plate or print from Sta. B to the center vertical line. From this point is drawn a light line, HJ, toward the center of the arc. Where this line crosses the arc, at J, a tangent, KJM, is drawn, which will show the location of the plate A-1 on the drawing. This line is called the trace of the plate. An object which appears both on plate A-1 and A-2 is next picked out and its location on the trace of plate A-1 determined by measuring the distance JN equal to the distance on the plate from the image of the object to the center vertical line. A light line, NO, joining this last-found point with Sta. A, is then drawn. Where this last line crosses the arc, at O, a tangent, OP, to the arc is drawn, and the trace of the plate A-2 is found with the aid of the point which appears on both plates just as plate A-1 was located from the picture of Sta. B. The traces of plates A-3 and A-4 are found in exactly the same way as was that of A-2. If the radius of the arc has been estimated correctly, Sta. C will be found to be exactly on the point where the trace of the plate showing the station crosses the line AC on the paper. If it does not fall on the line AC, which is generally the case, everything must be erased except the original triangle. First, however, a radial line S′G′, or S″G″, is drawn from the location of Sta. C on the trace of the plate A-2, 3 or 4, as the case may be, to the arc, and the point of intersection of this line and the arc, G′ or G″, is preserved. If this point, G′ or G″, is outside the base triangle, the next trial arc should be drawn with a larger mapping constant as a radius, or vice versa. If the second mapping constant is off, find again the point of intersection of the radial line through the new location of Sta. C on the newly located trace of the last plate and the new arc. Join this point and the one found previously, in the same manner, with a straight line, G′G″. The point G where this last drawn line intersects the line AC of the base triangle, will be the point through which the arc, with the correct mapping constant as radius, ought to pass, provided the first two approximations were not too far in error. This third trial ought to make the location of the traces of the plates exactly correct. If, however, the focus of the camera was changed between exposures at one station, the traces of the plates will not all be at an equal distance from the station point, and their location will be an almost impossible task. The traces of the plates taken at stations B and C are found in exactly the same manner as were those for Sta. A. After the traces have all been located, it is a good plan to ink them in lightly and erase the pencil construction lines which would otherwise form an impenetrable maze. The traces located, the difficult and tiresome part of the plotting is over; the landscape, brought indoors photographically, is located as with the plane table; all that remains to be done is to take the sights and find the points on the paper which show where the objects were on the ground.

This taking the sights is a simple



matter. With a pair of dividers, the distance from a given object from the center line of the plate is measured. This distance is laid off on the proper side of the point marking the center line of the trace of the same plate; a radial line is drawn through the trace at the given distance from the center-line point and the station at which the given plate is taken; this is one line of sight to the object. The same object is located from another station in the same way; as on the plane table, the intersection of the two lines to the same object marks the location of the point which represents the object on the map.

Obtaining elevations for the drawing of contours is a slightly longer process. Contours are lines joining points of equal elevation; they represent successive shore lines, if the area mapped were inundated and the water should rise slowly foot by foot. If the contours are close together, the ground represented has a steep slope, and vice versa. If, on a map, a number of points are of known elevation, it is simply a question of judgment and practice to tell where contour lines go.

Before contours can be drawn the elevations of a considerable number of points must be known. If the elevation of any one of them is known and the difference between that one and any other can be found, determining the elevation of the second point is simply a problem in addition or subtraction. If it be desired to find, for instance, the difference in elevation between Sta. C and the corner of the fence, as shown in the sketch, two solutions are possible, as follows:

First: Perpendicular to the line of sight from Sta. C to the fence corner, two lines are drawn, one at the intersection of the trace of the plate by the line of sight, and one at the point on the paper which shows the location of the fence corner. On the first of these two lines is laid off the distance Y′, equal to the distance of the ground at the fence post above or below the horizontal center line on the plate. Through this point, on the first perpendicular on the line of sight, is drawn a line through the Sta. C and extended to an intersection with the second drawn perpendicular. The distance from the corner of the fence, on the paper, to this intersection is the distance Y, the difference in elevation from the center of the camera at Sta. C to the ground at the fence post. This solution is longer and less desirable than the second.

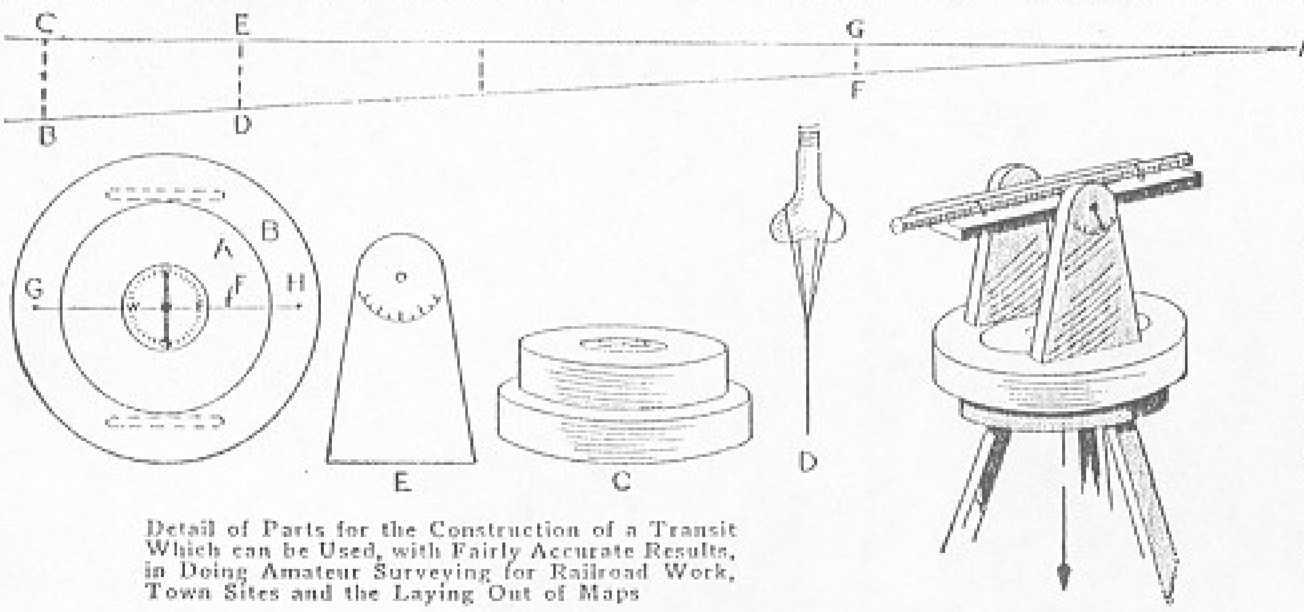
Second: In place of perpendicular lines to the line of sight, the trace of the plate, and a line, through the point representing the object, parallel with the trace, may be used.

A datum plane, or reference surface, from which all elevations are measured up to the ground surface must be assumed. The United States Geological Survey uses mean, or average, sea level for the datum in all its topographic sheets. Generally, unless there is a United States Geological Survey "bench mark," a monument of carefully determined elevation referred to sea level, within the limits of the survey, it is better to assume the elevation of some point, as Sta. C, at 100 ft., or greater if necessary to place the datum plane below the ground level at all points within the area to be mapped. Other elevations are figured from the assumed elevation of Sta. C. Allowance must be made for the height of the center of the camera above the ground at Sta. C in computing elevations above Sta. C. All elevations determined for the purpose of drawing contours are ground elevations and not the elevation of the top of objects located on the map. The topographic sheets of the Geological Survey are good examples to follow, in drawing contours. For many purposes, contours are not essential, and the refinements necessary for their drawing may be omitted.

How to Make a Surveyor's Transit

By BENNETT BLACKLIDGE

A boy who likes to do the things that "grown ups" do can derive considerable pleasure from the making of a transit, which will enable him to start in surveying railroads, laying off town sites, and doing lots of kindred work. It is necessary to have a compass, and one, 1¾ in. in diameter, can be purchased at a reasonable price. A hole is bored with an expansive bit into a board, ⅞ in. in thickness, just deep enough to admit the compass snugly, then a circle, A, 4½ in. in diameter, is drawn, having the same center as the compass hole, and the disk is cut out with a compass or scroll saw. A ring, B, is cut in the same manner from the same material, its inside diameter being such that the ring just fits around the disk A, and the outside diameter, 6¾ in. Another block, 5½ in. in diameter, is glued to the bottom of the small disk A. This will appear as shown at C. A small hole is bored in the center of the bottom block on the under side to receive the threaded end of the screw on a camera tripod. By careful adjustment the threads in the wood will hold the transit firmly. A plumb bob must be attached exactly in the center of the tripod head. This can be easily done if the head is wood, but in case the top is of metal, the line can be attached to the screw with a double loop, as shown at D, so that the bob will hang centrally. Two standards are made as shown at E, each about 5 in. high, and fastened to the ring B in the positions shown in the drawing of the complete instrument. An arc of a circle is marked on one of the standards, as shown, to designate angles, the markings being laid out with a bevel protractor. The pointer is a hand from an old alarm clock.



Detail of Parts for the Construction of a Transit Which can be Used, with Fairly Accurate Results, in Doing Amateur Surveying for Railroad Work, Town Sites and the Laying Out of Maps

The telescope arrangement consists of a piece of pasteboard tubing, about 1¼ in. in diameter, one end being cov-

ered with a piece of black paper with a pinhole in the exact center, and the other equipped with "cross hairs." Four small notches are cut in the latter end of the tube, exactly quartering it, and two silk threads as fine as can be obtained, are stretched across in these notches. The tube is fastened to a block of wood, 5 in. wide and 7 in. long, with small tacks and two pieces of fine copper wire. This block is pinioned between the standards with two nails. The hand is secured to the nail in such a position that it will point straight down when the tube is level.

The instrument is adjusted in the following manner: It is set up where a lone tree can be seen, about one mile distant, and the center of the cross hairs is carefully set on the tree. Then a very fine wire is stretched across the compass, as shown at F, and while keeping it directly over the center of the compass it is also placed on a direct line pointing to the tree. Very small brass nails, driven in at G and H, serve to fasten it in the position thus found. When this adjustment has been made the telescope can be turned to sight any object, after first placing the instrument so that the needle points to the N on the dial, and a glance at the wire will show the exact direction in which the object is located.

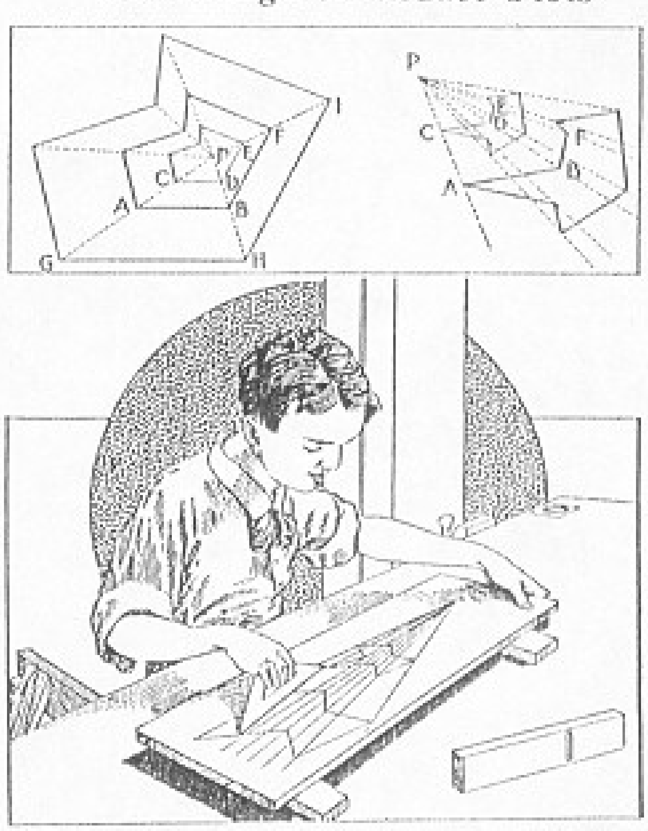
The instrument is then taken to a level stretch of road and set up, and a stick is placed on end and marked at the height of the telescope. The stick is taken along the road about 200 yd., the telescope sighted on it, and the hand set. This makes the instrument level enough for all practical purposes. The plumb bob is then dropped, a distance of 20 ft. measured from it on the road, and a mark made. The telescope is sighted on this mark, and a mark is made on the standard at the point of the arc, to which the hand points. Another 20 ft. is measured, or 40 ft. from the bob, and another mark made. The telescope is sighted on it, and the location of the hand again marked. This works well up to about 300 ft., then the marks begin to come very close together. This method is used for laying out town sites. The instrument is set up directly over a stake from which to work, and the telescope is turned down until the 20-ft. mark is indicated, when the operator looks through the telescope and tells his helper where to set the stake. Then another is driven at the next point, and so on, until the limit of the instrument is reached.

When doing railroad surveying several start out together, one with an ax to cut away brush; one to carry pegs; two to measure, or chain, the distance between stakes, and one to do the sighting. In this manner a line can be run that comes very near being perfectly straight for three miles.

A concrete example of how the transit was used to lay out a map of a ranch will now be given. The start was made on an east and west fence. The instrument was set 5 ft. from the fence at one point, and at the other end of the fence the stick was set at a point 5 ft. from the fence. When the stick was sighted, the wire cut the E and W on the compass, thus showing that the fence was set on a line, due east and west. The distance was measured from the fence to the house, which was ¼ mile, and this was noted in a book. This operation was repeated on the rear, and the distance found to be 780 ft. while the compass showed the direction to be 4 deg. west of south. The next line ran 427 ft. and 1 deg. east of south. This was kept up all the way around. After these notes had been obtained, it was an easy matter to take a piece of plain paper and strike a line representing north and south and lay off the directions. A bevel protractor was used to find the degrees. The transit was set on the posts of the corrals and this saved the measuring out from the inclosure. The creek was surveyed in the same manner. So many feet southwest, so many feet west, so many feet 5 deg. south of west, and so on, until its length was run.

The transit can also be used for finding distances without measuring. A line from A to B is sighted, and F represents a point ½ mile distant, the line from F to G being 100 ft. A line is now sighted from A, through G to C. A person standing at D is directed to move toward the point E and he is stopped as soon as sighted in the telescope. He then measures the distance from D to E. Suppose this distance is 250 ft. As each 100 ft. means ½ mile, and the 50 ft., ¼ mile, the point E is 1¼ miles from the transit. This method can be used quite extensively and distances obtained are fairly accurate.

To Enlarge or Reduce Plots



Enlarging and Reducing Plots by Radial Lines from a Common Point Located Properly

Sometimes it is necessary to enlarge or reduce a plot to a different scale. This can be easily and quickly accomplished without resorting to the slow process of protracting the angles and scaling the individual lines.

Take any point, P, and from it draw light pencil lines through each of the corners of the plot. On any one of these lines, as AP, lay off with dividers AC equal to CP. Place a triangle on the line AB and with a straightedge, or another triangle, laid on the line AP, slide the former to the point C, then draw line CD parallel with AB until it intersects the radial line PB. In the same manner draw line DE parallel with BF, and so on, all about the plot. A test of accuracy will be in striking the point C with the last line. If the original plot has a scale of 40 ft. to the inch the reduced plot would be 80 ft. to the inch. If it is required to enlarge the plot to 20 ft. to the inch, make AG equal to AP, and proceed as in the first case, using G as the starting point.

The location of the point P is arbitrary and may be outside of the boundary of the plot or figure to be enlarged or reduced, but should be so located, if possible, that the radial line to any corner does not parallel either of the plot lines to that corner. If the point cannot be so located for all the lines, it may be necessary to scale the lines. A little practice in picking out the best location for the point will give gratifying results. — Contributed by Junius D. McCabe, Pittsburgh, Pa.

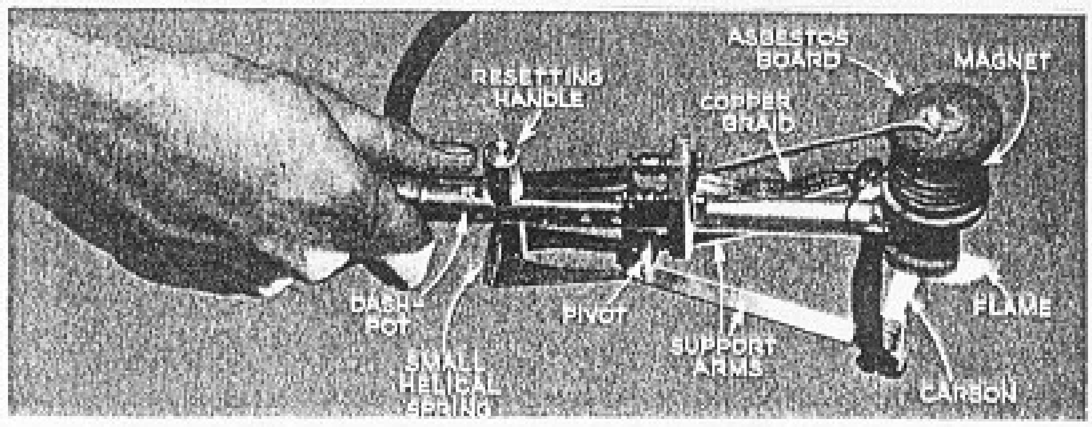
Unique Electric-Arc Torch

WELDS SMALL WORK

By Edward Shaw

POPULAR SCIENCE MONTHLY

MARCH, 1937



An electromagnet deflects the flame of the carbon arc outward in a long point that can be used for welding

BY UTILIZING the intensely hot flame of a carbon arc, it is possible to construct a new and curious type of welding torch for experimental purposes or small work in the shop. The arc is deflected by means of an electromagnet into a long pointed flame, which can be used for various purposes. The torch illustrated, for example, was designed for welding wires of very high melting point (chromel and alumel) used in the construction of thermocouples. An oxy-gas flame would, of course, do the same work, but is not always available.

There may be the germ of an idea in this torch that could be developed into something more practical and useful. Possibly the magnetic field could be so adjusted and shaped that one could form the arc into a long, slender flame, more concentrated than at present. It is interesting to note that the arc roars more on alternating than on direct current and the flame is more concentrated and pointed in the forward direction.

The electric arc which is formed between two carbon rods in contact arises from the vaporization of the rods when sufficient current flows through their tips. The hot conducting gases produced at the point of contact maintain the arc at the expense of the carbon rods, which slowly wear away. That these hot gases or flames consist of electric charges in motion is shown by the fact that they are deflected by a magnetic field.

The small torch described consists of two ¼-in. diameter carbon rods above which is mounted an electromagnet and through which the current of the arc flows. The magnet is connected in such a way that its field deflects the arc outwards so that it becomes accessible for experiment. The magnet consists of a ½-in. diameter soft steel core wound with approximately 85 turns of No. 14 cotton-enamel, copper magnet wire. The ends of the coil are made of asbestos board to protect the winding from the heat, and the whole unit is mounted in the end of the slotted tube shown.

In order to compensate for the wearing of the carbons, a device is provided to bring them together slowly. This is made very simply and consists of a dashpot, the shell of which is the handle of the torch. So that the motion will be quite slow, the piston moves through a heavy oil. A hole is drilled through the piston in the direction of its travel to accommodate a tube of approximately 1/32-in. bore and 1/64-in. wall. This should be a force fit. The tube is allowed to extend a bit beyond the face of the piston, so that it may be squeezed together if necessary to make an adjustment. A strong, phosphor-bronze helical spring, pushing against the piston, drives it through the oil, which flows through the tube. Both the size of the hole through which the oil flows and the grade of the oil may be used to regulate the piston's speed of travel. To allow for a rapid resetting of the piston, a flap valve of .005-in. spring steel is mounted on the end of the piston over a ⅛-in. diameter hole. It is important to solder this valve to the piston as far from the hole as possible to prevent permanent bending by the sudden rush of oil as the piston is reset.

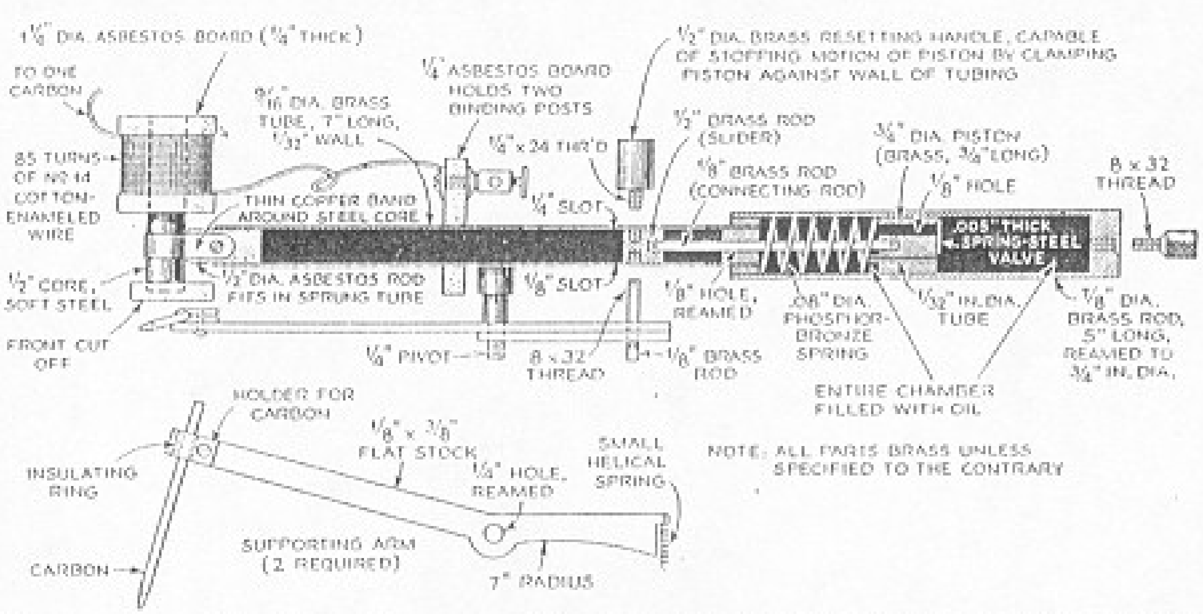
A slider, fastened to the outer end of the connecting rod, has a small pin attached to its underside. This communicates the motion of the piston to the two carbon-support arms. On the top of the slider is a small handle for resetting the piston.

The carbons are held by split clamps and insulated by a heat-resisting material, such as asbestos. The carbon-support arms are about 4 in. long and shaped as shown in the sketch. The curve along which the pin slides approximates a circle with a radius of 7 in. A smooth curve is necessary to make the carbons move together evenly. A small helical spring is attached to the far ends of the two carbon supports to bring the two carbons together.

The arc and the electromagnet are connected in such a way that the flame is blown outward. The leads to the two carbons should be made of flexible copper braid in order not to interfere with their motion.

The arc shown in the photograph required 8 amperes direct current. However, when this is used, the carbon connected to the positive terminal should be larger than the negative carbon because it wears away nearly twice as fast. With alternating current, both carbons can be the same size.

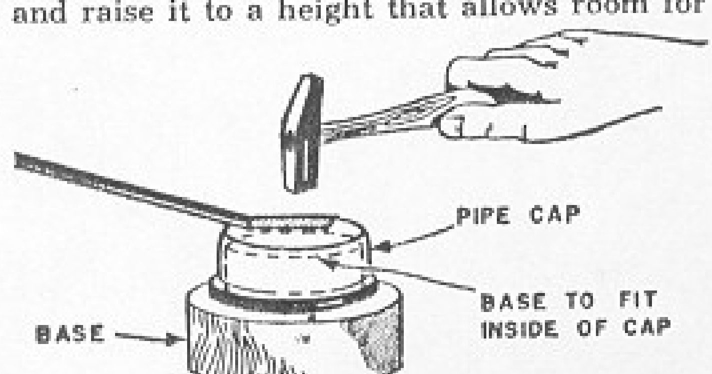
The dimensions given are suggestive of a model made by the author, but the size of the torch may be modified to suit individual desires.



The experimental torch has an ingenious dashpot arrangement in the handle to regulate the arc

Pipe Cap Is Bench Anvil

• A 1¼-in. or larger pipe cap can be used as an anvil for light work. Mount the pipe on a base turned or glued-up to fit inside the cap and raise it to a height that allows room for

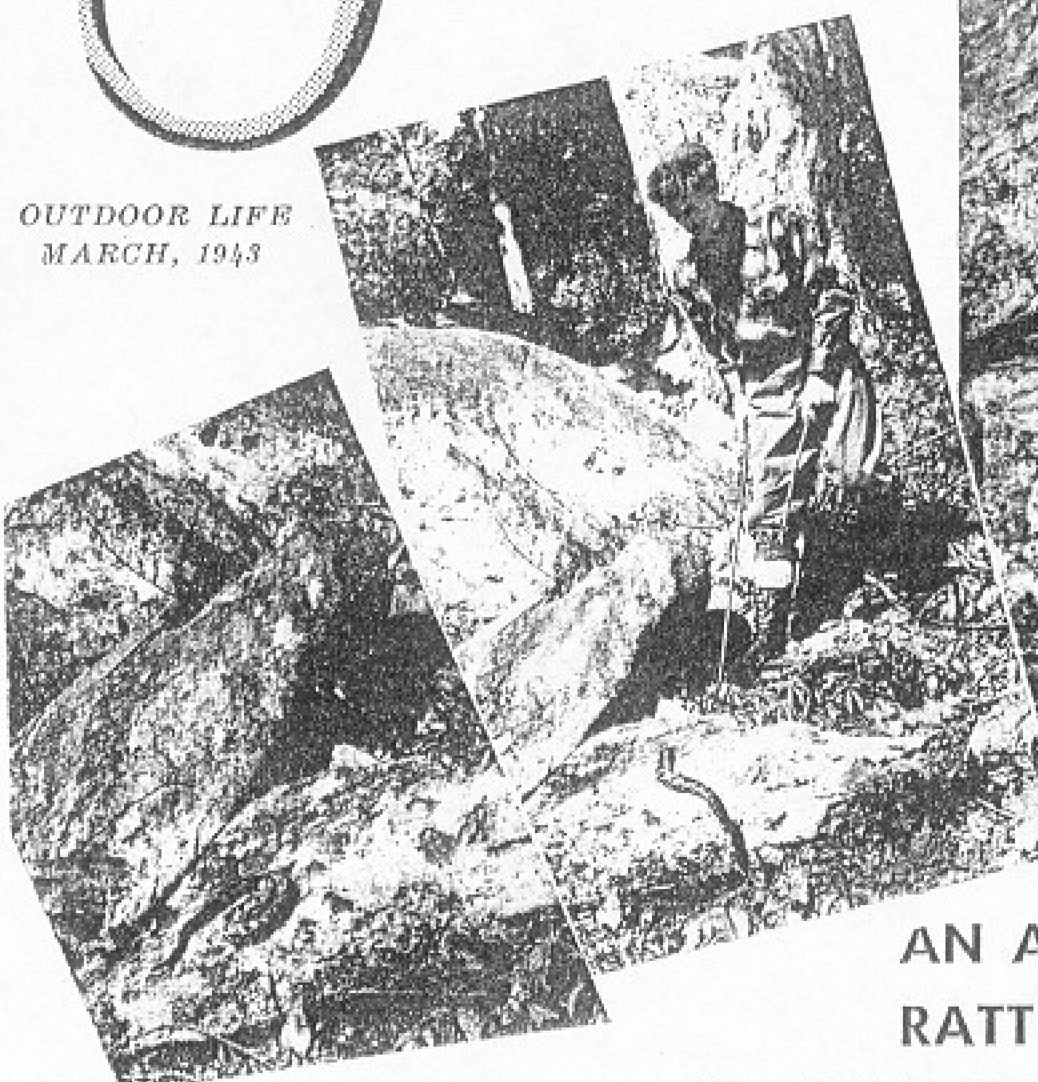


your fingers alongside of it when holding the work. Polish the top of the cap if it is to be used for metal shaping, or leave it as is for ordinary nail straightening and riveting.

SNAKE MAN

By
ISABELLE
KAUFFELD

OUTDOOR LIFE
MARCH, 1943



These six pictures show how Herb Nichols captures a timber rattler alive. He spots one sunning itself on a bowlder and approaches quietly, but the snake, aroused, attempts to escape. Nichols quickly grasps it with a special clamp rod . . .

AN AMATEUR PROVES THAT FEAR OF RATTLERS CAN EASILY BE OVERCOME

EVER since the Garden of Eden, snakes have been more-or-less unpopular animals, classed by some as "varmints," and giving timid souls shivers of fear whenever they see one. But there are people who like snakes—are even quite devoted to them—and in almost every community one finds a "snake man," who, for his peculiar hobby, earns the admiration, incredulity, or ridicule of his neighbors.

In Dutchess County, New York, such a man can be found in the person of Herb Nichols, who has adopted the slogan, "Keep 'Em Crawling." Nichols, a slim, gray-haired man of fifty, has not always been a snake fancier. Unlike the usual small boy whose pockets, to his mother's horror, are cluttered up with frogs, turtles, and snakes, Nichols did not give much thought to reptiles until a few years ago, although he had been a woodsman enjoying fishing and hunting. Now his gun and his fishing tackle are hardly ever lifted from their racks, but his snake hooks are always at hand and show plenty of wear.

It was only seven years ago that Nichols's hobby had its beginnings and put him on the way to becoming an amateur herpetologist. Up to that time he had been a city house painter, taking occasional vacation trips into the country. Various circumstances, principally a slack period in his business, caused him to accept the position of caretaker of a lonely piece of property on a mountain top a few miles from the town of Wingdale, New York. His nearest neighbor is three precipitous miles down the mountainside.

Snakes are numerous in that country; Nichols found that out soon after he had taken up residence there. The first rattler that he encountered so surprised and scared him that he almost broke a leg jumping away from it. The incident occurred one day when he was weeding a flower bed in front of the old barn, which he had converted into a home.

Nichols was on his knees pulling weeds and absorbed in admiring his flowers, when he thought he heard a rustling sound in the grass near him. He didn't pay much attention, assum-

. . . and holds the rattler firmly while he maneuvers a forked stick. There! The fork pins the reptile's head; now Nichols can grasp it tightly behind the head with his bare hand and drop it into a carrying sack

ing it was just a field mouse, until he heard the sound again—closer this time. Casually glancing up, Nichols was startled to see a big timber rattler, about six feet away, staring curiously at him. Without a moment's hesitation, he sprang up from his kneeling position and landed on his feet six feet in the opposite direction.

"I'll always be sorry for what I did next," Nichols relates. "I obeyed my first impulse, ran for my gun, and put a bullet right through that snake's head. If I had only stopped to realize that he was just hanging around to help me rid the barn of rats and mice, I never would have dispatched him so neatly."

The skin of this snake, the bullet holes plainly visible, is mounted and hanging in a local tavern, mocking the now reptile-minded Nichols every time he looks at it. That's the first and last snake he ever killed.

As soon as he began to realize, Nichols said, that the snakes were more afraid of him than he was of them, and that they would leave him alone if he gave them a chance to escape, he decided not to molest them. Then he began studying them, casually at first, with the few books on reptiles available to him. His interest deepened, the more he learned, until he finally became an acknowledged snake man.

The neighbors around East Mountain did not share Nichols's enthusiasm for snakes, and most of his pleas for a policy of "live and let live" fell on deaf ears as far as snakes were concerned—either venomous or harmless. Even though he spent hours explaining, to anyone who would listen, that snakes feed on rats and mice, and therefore help the farmer keep these rodents under control, he still made few converts.

One farmer near the foot of the mountain was particularly averse to snakes and killed them on sight. If Nichols was there when the farmer saw one, he would let the snake fancier catch it alive and take it away. So Nichols was exceedingly surprised this spring to have this farmer stop him one day and tell him that there was a black snake around the farm, and that he didn't want Nichols to lay a hand on it. In fact he wanted very badly to have it live right there. Nichols looked incredulously at the man. Realizing that his right-about-face needed amplification, the farmer explained that his property was overrun with rats that had become so bold they even stole young kittens out of a box in the barn for food.

"You were right about snakes, Nick," the farmer admitted. "I won't kill any more and if you see 'em around here, leave 'em be."

Other farmers have come around to this way of thinking, too, Nichols said, although with most of them the tolerance doesn't extend to rattlesnakes and copperheads.

"I can understand their attitude," he said. "Especially if they have children. I can't expect them to welcome poisonous snakes on their property. So they are glad to let me hunt on their land and take away as many of the dangerous ones as I can find."

Through careful observations and deductions, he has located a few snake dens in the county, to the envy of other herpetologists. This knowledge assures him of a good catch in the spring, when the snakes are coming out of hibernation and are still in the dens, and in the fall when they are returning for the winter's sleep. He knew the type of rocky hillside that snakes like for a den, but for some inexplicable reason the reptiles will choose one in preference to another that seems equally good to the human eye.

Nichols knew that rattlesnakes and copperheads must have hibernating dens on his mountain or on adjacent ones, but without knowing the exact area where they congregated, hunting for them would be like looking for the proverbial needle in the haystack. He looked for them anyway, of course, for a snake man is necessarily an enthusiast and an optimist, but when he stumbled on a den it would be by pure luck. This hit-or-miss method could be improved upon, he believed, by outthinking the snakes. Men are smarter than snakes, after all, but the solving of this problem even then depended a great deal on luck. If snakes congregate in one spot for the winter, Nichols reasoned, and disperse over the surrounding countryside in the summer, then they must travel away from the den in the spring and toward it in the fall. That seems simple enough, but the luck comes in finding and observing the

snakes as they crawl to and from the dens. Nichols considers himself fortunate in seeing, from time to time, enough snakes crawling in one direction in the spring and in the opposite direction in the fall to correctly surmise the exact hillsides which they chose for winter quarters.

Nichols is reticent about disclosing the locations of the dens for fear of too many snake collectors depleting the snake population and upsetting the balance of nature. He himself only collects enough for his own needs, or to exchange for different species with collectors in other parts of the country.

Perhaps we had better explain here why any man "needs" a snake. A snake man wouldn't be a snake man if he didn't want to keep a few as pets. Besides, he usually wants to tell people

End of a hunt: the Snake Man comes down from a lonely mountain with a bagful of reptiles

all about his reptiles, to satisfy their curiosity and to interest them in looking with favor on these unloved children. The best and most showmanlike way is to display living specimens, which have a morbid appeal for the fearful and a fascination for the open-minded or the already-converted enthusiast.

The one place to find the largest gathering of rural people is at the local annual fair. Several towns within a short distance of Wingdale have these shows during the summer, and at most of them you will find Herb Nichols in his portable snake pen, answering questions and handling his charges for the benefit of hundreds of spectators. His banner reads "Schagticoke Snake Farm," although it is a misnomer as far as "farm" is concerned. It is practically impossible to "farm" snakes because they usually do not breed in captivity. Schagticoke was chosen because East Mountain is part of the Schagticoke range, named for the Indian tribe which inhabited the region, and which now has a reservation in the mountains near Kent, Connecticut.

The East Mountain "farm" is merely a large, open-topped inclosure, with sides chest high. The board planking is sunk a short distance into the ground and the top has a wire-netting flange; thus no snake can burrow or climb out. The interior has been supplied with rock piles, dirt mounds, dead leaves, and a cover at one end to provide the type of hiding places dear to a snake, and to make it possible for the inmates to have sun or shade as they prefer. Various species live peaceably together in this large pen, although some of the smaller specimens disappear from time to time when there is a large, cannibalistic snake among them.

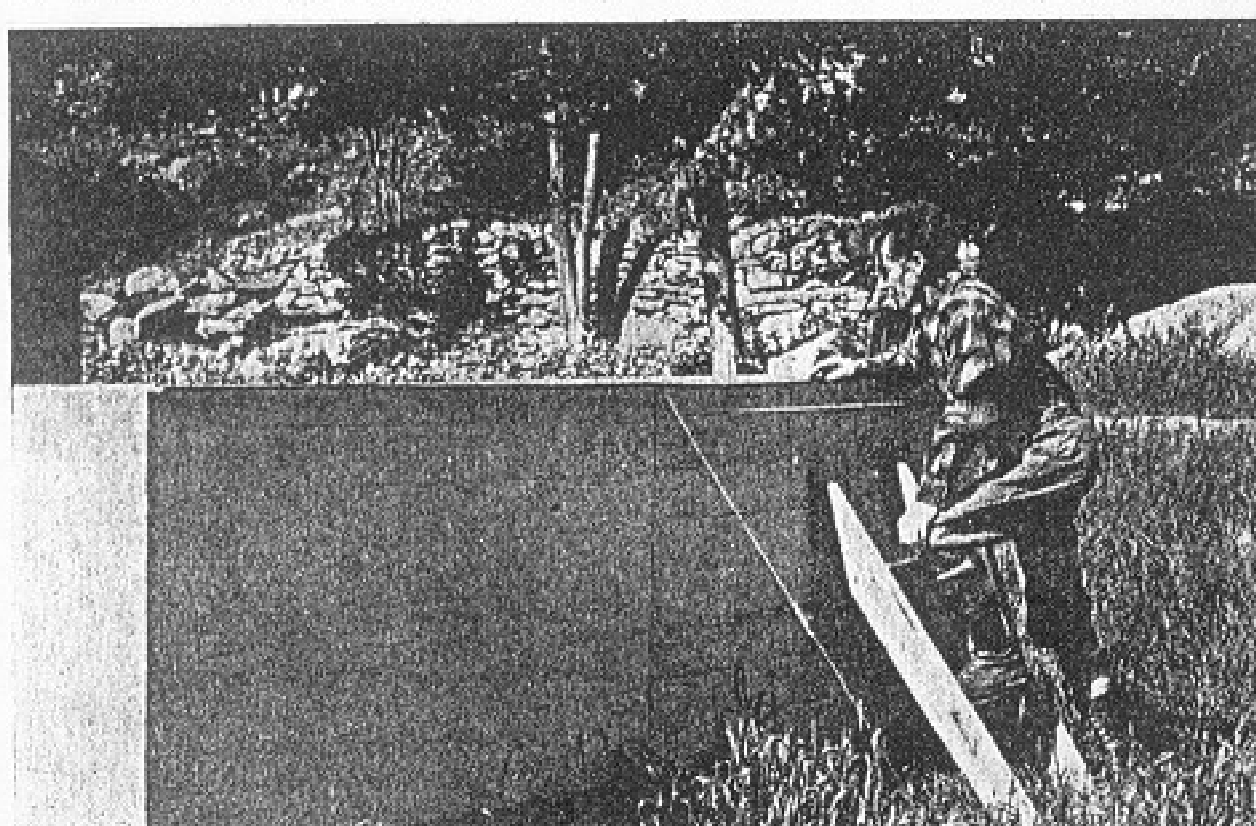
Nichols tries to provide enough food to keep his pets satisfied, but sometimes a garter snake will appear more succulent to a black snake than a frog or a mouse. Collecting frogs used to be easy, as there were always plenty in a spring on the place, until a couple of raccoons found out about it and decided to settle down there. Now Nichols has to go farther afield looking for frog ponds. In catching field mice he gets competition from his two cats, so he has had to establish another "farm" to breed mice to feed his reptiles.

The equipment needed for snake hunting is very slight, according to Nichols, but the most important thing is a good pair of eyes able to spot a snake in its natural surroundings. The coppery-colored copperhead, for instance, blends perfectly with the brown, dead leaves in the rock crevices it inhabits, and the sulphur-yellow-and-black pattern of the timber rattlesnake is hard to distinguish on a sun-dappled bowlder.

In catching a venomous snake it is necessary to pin down the head before picking the animal up by the back of the neck. For this purpose a stick, cut with a fork at the end, is used. Snakes in mountainous country are never very far from a hideout, for which they will make a dash when danger approaches. To catch them before they disappear, the snake hunter should have a stick with a clamp at the end with which he can clasp the snake and prevent it from crawling into a hole or under a rock ledge. After the hunter has got a good, firm grip at the back of the snake's head, he drops the forked pinning stick and with his free hand pulls out a cloth bag hanging from his belt. The tail of the snake is place in the open bag, then the head is released with a quick, downward thrust, and the top of the bag twisted closed and tied. The bag, usually about the size of a pillowcase, is all that is needed if one is hunting only non-poisonous snakes, as they can be picked up with the hands without danger.

Nichols always carries a snake-bite kit—containing a blade, suction cup, tourniquet, and other first-aid materials —but he has never been bitten while collecting snakes in the field or while handling them at home. Once, however, at a fair, a timber rattlesnake sank its fangs into one of his thumbs. This caused so much excitement that the management has never allowed him to show his snakes at that town fair since.

"Just a little chesty," is the explanation Nichols gives as the reason for that single bite. "Just a little overconfident. To prove to the crowd that snakes aren't really bad-natured, I had offered early in the evening to pick up with my bare hands any snake in the pen. At that time I had timber rattlers, copperheads, and a variety of nonpoisonous snakes, but had forgotten that one big timber was a newly caught specimen, which I had picked up on the road on my way to the fair. After I had handled most of the snakes in the pen a couple of hundred times, I began to believe myself that none of my 'pets' were dangerous. Then someone pointed to a big, black fellow, and said he bet I wouldn't pick *that* one up. A challenge like that, of course, had to be accepted, so without realizing it was a new snake, not accustomed to me, I didn't use proper caution and picked it up as though it was an old-timer. Quick as lightning,



Nichols enters the snake pen. Here he gives lectures and demonstrations with live snakes

the rattler twisted loose from my grip behind his head and stabbed at the closest finger."

NICHOLS gave himself first-aid treatment and then was rushed to a doctor. While in the doctor's office he heard someone from the fair announce that officials were going to shoot all the snakes in the pen. This was too much for the snake man to stand; although hardly able to walk, he insisted on going back to the show grounds and putting his snakes into their cages. Not until then would he go to a hospital. Within a week he was back at work without ill effect from his unfortunate experience.

Not only famous in his own community as a snake man, Nichols has a wide acquaintance throughout the country as well—mostly made and fostered through correspondence — with other amateur and professional herpetologists. A favored few of these reptile enthusiasts, who can get to East Mountain, visit Nichols in the "season" for snake-hunting trips.

The primitive country life he leads has become so enjoyable to Nichols that he says he will never forsake it to return to city existence. He is perfectly happy living alone on the top of a mountain, his only companions being two hound dogs, two cats, five goats—and his snakes.

WONDER STOVE

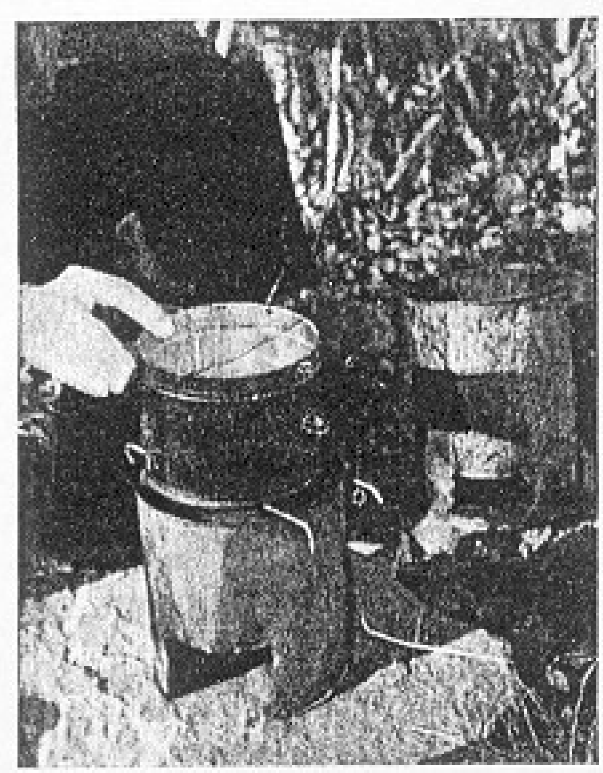
FROM OLD TIN CANS . . .

It will boil, bake, and fry a complete outdoor meal over a tiny twig fire, and deliver it to you all hot and ready to eat at the same moment

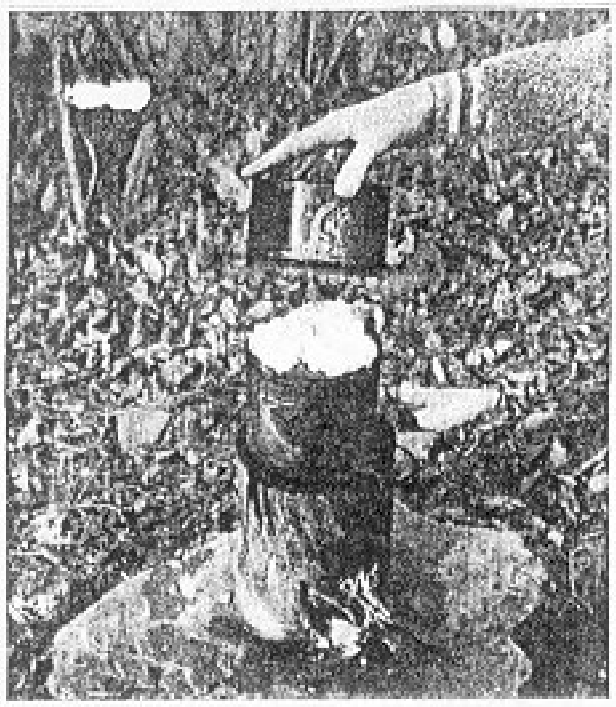
FOUR tin cans and some wire—less metal than the utensils they substitute for, much less the usual camp stove —are everything you need to make this novel cooker developed at Cornell University under direction of Dr. E. L. Palmer. Materials are a 5-qt. motor-oil can, a No. 10 food can, two coffee tins, two bent wires. Smaller parts nest into the large can for carrying on the trail.

Setting up the stove—and meal. First unit is the fire box, made from the food can with a cut at bottom to admit fuel and three pie-wedge openings in the top to let heat rise

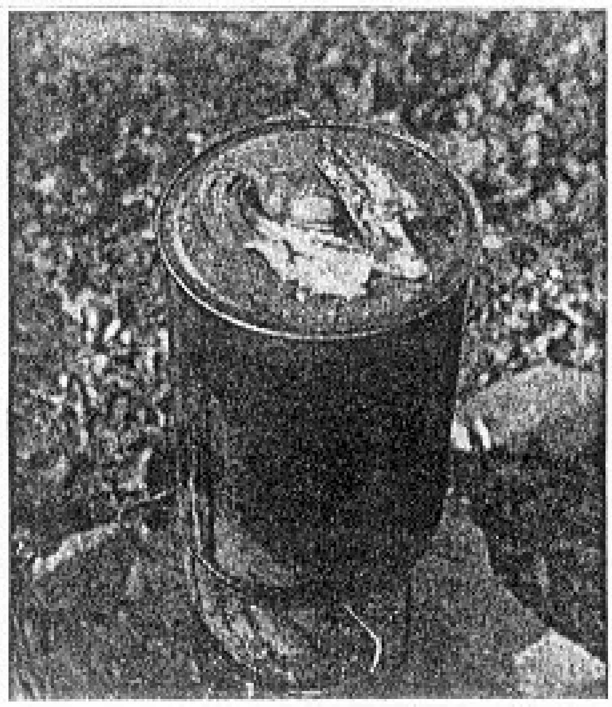
Wires are laid across the fire box; then a cover from one of the coffee tins is laid over them. The flat rock makes a good base but isn't essential; dry, flat earth will do



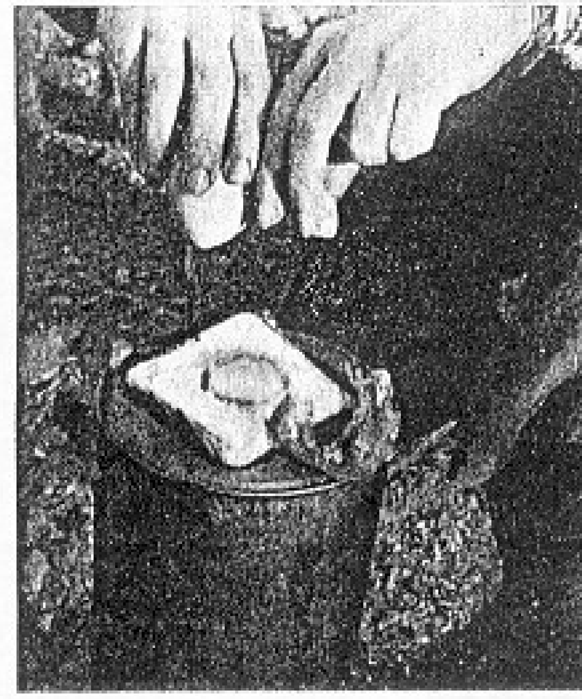
Next comes a coffee tin of water for tea or coffee. If neither is wanted, this tin may be used to boil potatoes or other vegetables or to heat up soup or precooked baked beans



The baking compartment—a coffee-tin lid set atop the "kettle" with the tin itself for a cover—is now loaded with biscuit dough. It could be used to heat canned goods instead

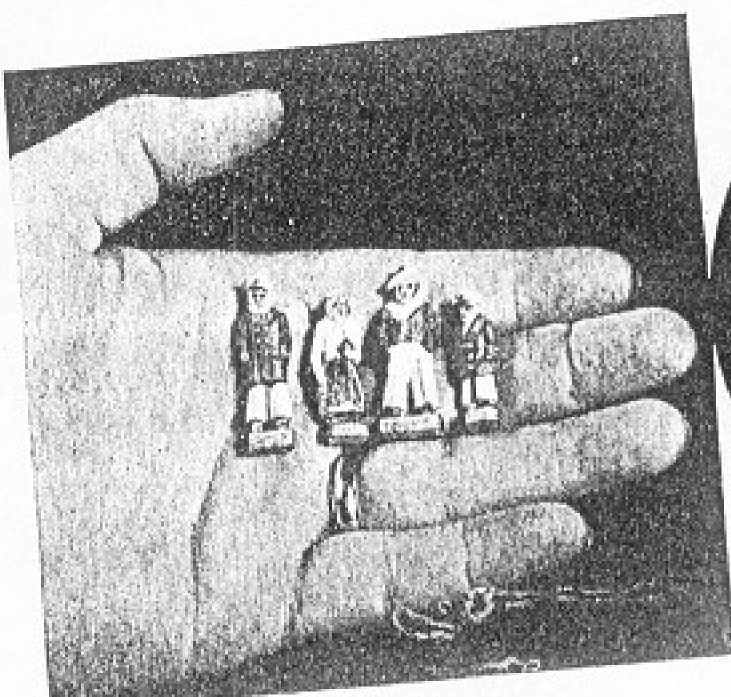


The oil tin slips down over all, to rest on the wires and keep the rising heat confined until it passes out the top vent on far side. Meat, fish, or bacon and eggs fry on the top

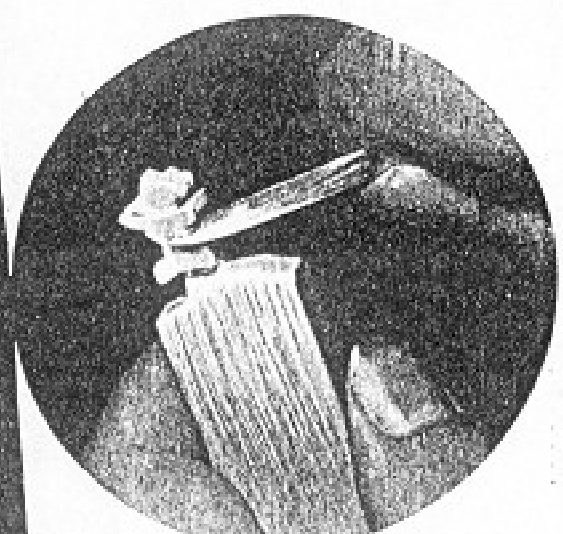


A good camp kink in itself! The egg is fried compactly in a hole in the bread—eaten as a sandwich. Since frying is quick, food below should be ready when this is, if timed right

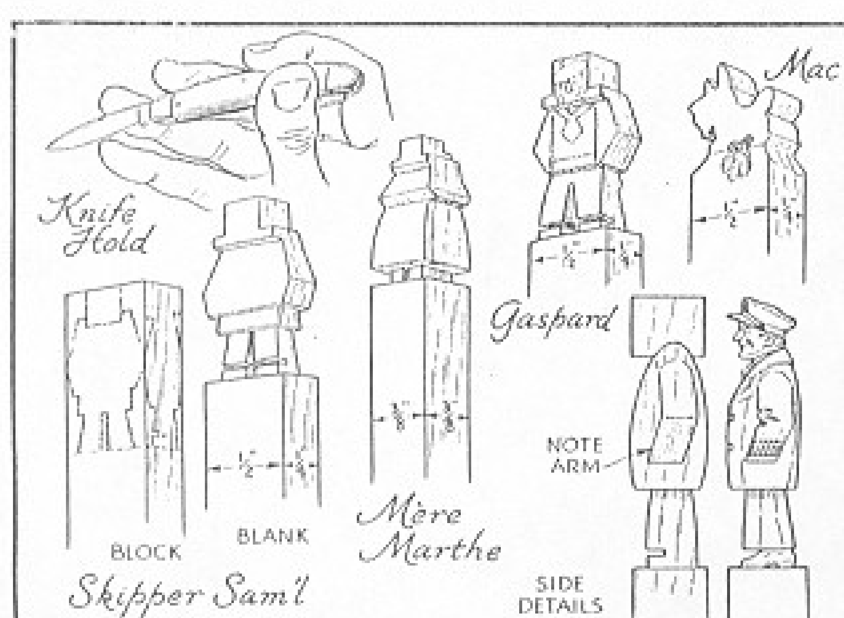
Miniature Figures Easily Whittled with a Penknife



Four pocketknife miniatures, the largest 1¼ in. tall



Cutting a Scottie and, right, how figures are blocked out



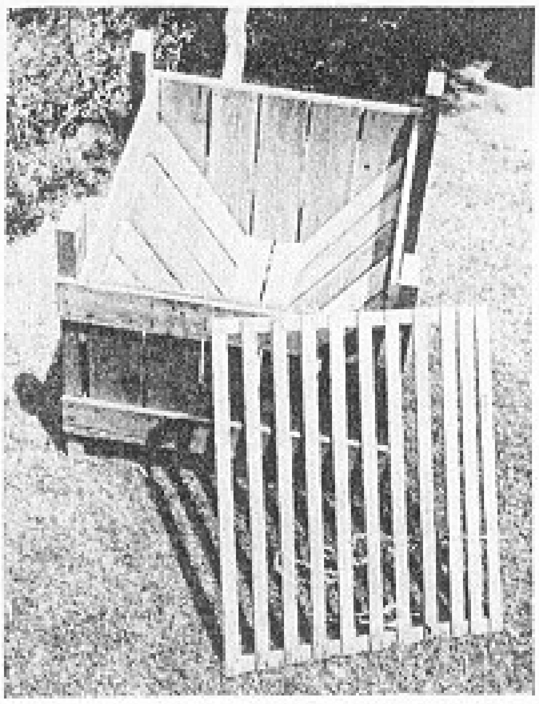
YOU'VE whittled Skipper Sam'l (P.S.M., July '35, p.63), Mère Marthe (Dec. '35, p.68), Gaspard (Dec. '36, p.68), and the six little Scotties (Feb. '36, p.63) as mantel decorations—now try making them in miniature size for curios, ornaments on paper knives, boxes, and book ends, or as the crew for your ship models. Such tiny figures (the larger sea captain in the photo is only 1¼ in. tall) do not require much detailed cutting. Just block them out carefully, and painting will do the rest.

Any small pieces of soft white pine or basswood will serve. I used thin strips about ⅜ by ⅞ by 4 in. The only trick is to lay out the blank at the end of the stick and carve it while using the rest of the stick as a convenient grip.

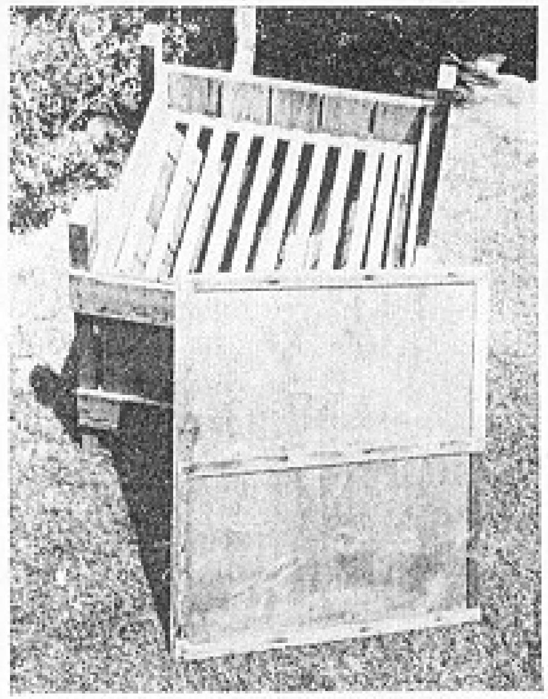
It is important to keep your knife blade sharp. To obtain accurate cuts and avoid overcutting or too great cutting pressure, it may help to hold the knife as sketched, using the tip of your little finger as a guide against the blank. It may also be easier, particularly in face details, to hold the blade near the tip, like a penholder. In shaping many parts you must use the tip of the blade almost entirely. For cuts at the base and general shaping, the center of the blade will work satisfactorily.

I normally make Scotties as shown in the photo, with the grain running from nose to tail, but it may be easier for you to make them as shown in the sketch, with the grain running vertically through the body. The latter minimizes the chance that the ears, eyebrows, and tail may break off, but be very careful in separating the legs.

A somewhat opaque color, like show-card colors, is the best for this work, because it dries quickly and does not sink in, although water colors will do.—E. J. TANGERMAN.



There's room for 10,000 earthworms in this culture bed. It stands 36" high and 36" wide, with ¼-inch ventilation space between all members



Burlap tacked on lath frame forms the top cover; burlap is also used for side walls. The bed can be made of most woods; pine is the best of all

Dr. Thomas J. Barrett, earthworm authority and "grower," waters burlap walls and top of culture bed to insure the proper moisture within

EARTHWORMS

SUNSET JANUARY 1942

NOT SINCE DARWIN'S claim that the fertility of the uppercrust of our soil was largely due to the common earthworm has that animal received such a bright light of publicity as is now directed on it by Dr. Thomas J. Barrett. Although he has already received nationwide notice in periodicals, the doctor is now producing a book *Harnessing the Earthworm*. We asked Dr. Barrett to tell exactly how the home gardener would go about putting the earthworms to work. This is what he wrote:

POPULATIONS

One million earthworms in an acre of ground will transform upwards of 200 tons of dry topsoil material per year, delivering this finely divided and conditioned earth to the surface in the immediate root-zone to richly nourish all vegetation.

The ancient Greek philosopher, Aristotle, called earthworms the "intestines of the earth," a phrase which literally describes the function of these master-builders of topsoil. Streamlined to the ultimate for functional performance, the earthworm blindly eats his way through the ground, riddling and honeycombing it to a depth of ten feet or more with his aerating tunnels as he swallows the earth with all that it contains—dead roots, vegetable and animal remains, bacteria, the minute and microscopic vegetable life of the soil, and mineral elements. In the muscular tube of his body—a mechanical mill and chemical laboratory—all material is broken down to serve nutritional requirements. The secretions and excretions of the worm add valuable animal hormones and elements to the semi-liquid mass of material, as it passes slowly through his body to final excretion in and on the surface of the earth as castings—humus. Earthworm castings constitute the richest topsoil and potting material known to science, containing as they do in high proportion and water-soluble form all the elements of plant nutrition.

Good garden or farm land will easily support one million or more earthworms per acre. This represents a population of approximately 10 worms per cubic foot, figuring an average working depth of 30 inches. How can the gardener, orchardist, or farmer be assured of 10 working soil-builders per cubic foot of land? The answer is, propagate earthworms scientifically and intensively in special breeding beds and seed the land with sufficient egg-capsules to insure the maximum population.

HERE'S HOW

Here's how it is done: 1. Compost for earthworm food for intensive production of capsules is made by thoroughly mixing one part of good topsoil with one part well rotted manure, and one part vegetable matter such as alfalfa, grass clippings, or other available vegetable waste. Fill the culture bed with the mixed compost to within 6 inches of the top, thoroughly wet the material down till it is moist all the way through.

2. Impregnate the bed with 2000 earthworm egg-capsules, now commercially available. Capsules should be planted about 2 inches deep, distributed over the surface area of the bed. Place the lath subsurface divider (see photo) on top of the compost, adjust covers, and leave undisturbed for 60 to 90 days except for sprinkling enough to keep contents of the bed moist throughout but not soggy wet. By the end of this period several thousand worms will have hatched out and reached maturity, the bed thus becoming fully populated with breeder stock for production of capsules.

HARVESTING

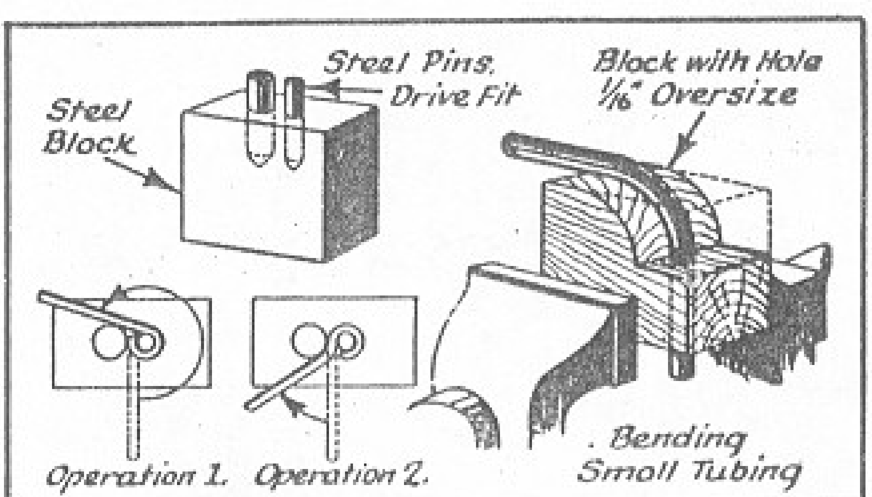
3. For producing and harvesting capsules, mix compost as directed and place a layer of the material 4 to 6 inches deep on top of the

sub-surface divider. Wet the material down and keep it moist by frequent sprinkling through the cover. The breeder worms will move into this top layer, feeding on the compost and depositing their castings and egg-capsules in this surface layer. Under proper conditions, domesticated earthworms will pass one egg-capsule every 7 to 10 days. As the incubating period before hatching is from 14 to 21 days, all of the capsules may be harvested by removing the surface layer of compost down to the sub-surface divider every 2 or 3 weeks. The compost below the divider forms the permanent burrows of the breeders and should not be disturbed except at intervals about twice yearly when it should be renewed. In harvesting, the covers should be removed and the material allowed to dry out for a few hours. Then remove it layer by layer, raking about one inch at a time and allowing a few minutes to elapse before removing the next layer. The mature worms will rapidly work downward and take refuge beneath the divider. Spread the harvested material on a piece of canvas to further dry for a short time, then sift through a ¼-inch screen. The castings and capsules will pass through the screen. The coarser material can be mixed in with fresh compost and returned to the bed. Proceed as before, filling in compost above the divider and repeating the harvesting procedure every 2 or 3 weeks. The harvested material may be used for impregnating flower pots, flower beds, lawns, or other land, or may be used for impregnating extensive compost heaps. Wherever a handful of this material is buried in well watered earth an earthworm colony will be established, to breed and spread to surrounding earth in an ever-widening circle. Following this simple technique, from a small inexpensive beginning thousands of dollars worth of highly valuable earthworm culture may be produced. The sure way to build up fertile, productive topsoil, or provide ideal potting material is to put the master-builder of topsoil —friend earthworm—to work.

Wire Bending Jigs

YOU have often been working along in the finishing stages of building some gadget that needed a small steam pipe bent, or a wire hook that would complete the control system of some engine. And then pops up the question: Where will I get jigs to bend the stuff around?

Why not make a set like these and have them in your kit? Time after time they'll come in handy. Bending rods to a desired shape is not easy, nor is the handling of tubes without such equipment.



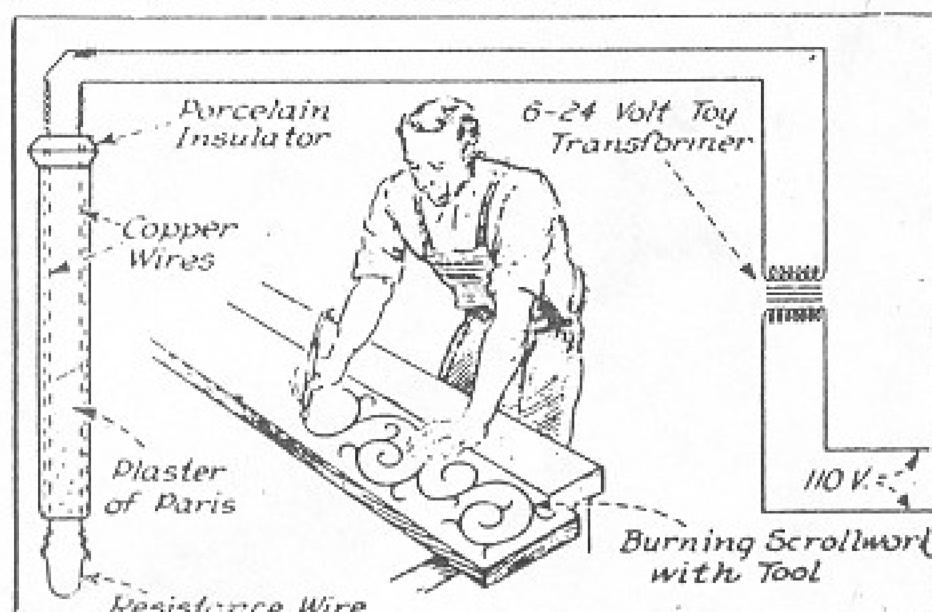
Small jigs on which to bend wire should be a part of every metal worker's equipment. Here are useful little jigs easy to make and very useful in service.

Mechanical Pkg. Magazine 1932

Small eyes centered on the end of a rod are quickly made with two pins in a hardwood block. A hole bored in another block with a rounded corner will be found useful in working ⅓ o. d. copper pipes.—Morris Hall, White Plains, New York.

Mechanical Package Magazine — 1932

Electric Wood-Burning Tool



THE old style art of "pyrography" is rather out of date, but a wood-burning tool still has many uses in the workshop. It is useful in burning identification numbers on tool handles and in decorating various types of wooden models.

Get a porcelain insulator of the type shown and strip two lengths of copper wire, each two inches longer than the insulator. Run them through the insulator, permitting an inch to extend from each end, which is bent over to hold them in place.

How to set and align fence posts

SUNSET MAY 1965

Sooner or later most homeowners face the prospect of setting and aligning fence posts. It can be quite a trial. We've talked the problem over with fence contractors, tool rental firms, and do-it-yourselfers, and we have a few suggestions that may make your next fence-setting job go more smoothly.

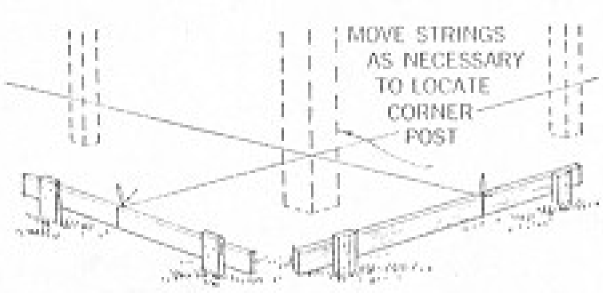
For long fence life, use posts of Western red cedar or California redwood. These woods inhibit the decay-causing action of fungus and insects. Specify *heartwood*, the reddish brown wood from the central part of the tree; sapwood, the lighter wood close to the bark, is much less durable.

Mountain cypress, sometimes sold in the Southwest for fence posts, seems to endure as well as cedar and redwood.

DIGGING THE HOLES

For low fences, sink posts at least 18 inches into the ground. For fences 4 to 6 feet high, sink posts at least 2 feet; the deeper the better, especially if the completed fence will present a solid barrier to winds.

Moisture should be able to drain quickly past the bottom of the posts. For this reason dig holes 4 to 6 inches deeper than the posts will be set, and fill the bottom of the holes with rocks and gravel. In clayey soil, it's wise to go down even farther, to provide a foot-deep drainage basin of gravel beneath each post.



Batter boards *in firm ground near corners help you position corner posts precisely*

Locate the fence's corner points, if not self-evident, by using string and guides called *batter boards* (see diagram). Mark string into the post spacing desired (6 and 8-foot spacing is most common, and allows economical use of standard lengths of lumber, but other spacing is often dictated by type of fence, appearance desired, slope of ground). Over uneven ground, drop a plumb line from each string mark to pinpoint post locations, and drive in marker stakes. Then begin digging.

Digging tools. Of the two most popular hole-digging tools, the auger type is fine in rock-free earth, the clamshell type better in rocky soil. Digging is still tough work even with these tools, but the resulting hole (especially with the auger) is much slimmer than with pick and shovel digging, and gives better support for posts and backfill. And less fill is required—an important consideration if you are setting the posts in concrete.

Each tool costs about \$8 to \$12 to buy, and 75 cents to \$1.50 a day to rent. In really rocky soil, neither works well—you're right back to pick and shovel.

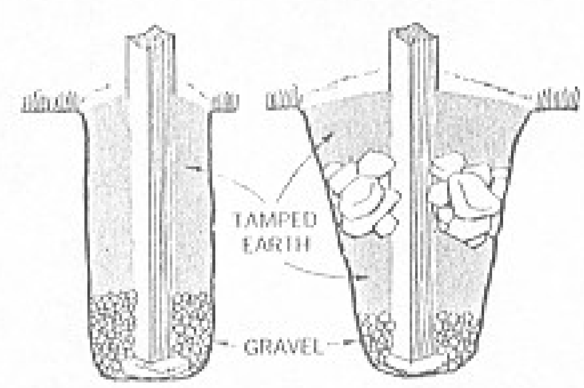
If you have more than six holes to dig, and the earth is not too rocky, power diggers are certainly worth investigation. One-man and two-man power augers are often available at tool rental shops. We recommend you get a husky friend to help you, and rent a two-man unit; it can dig a 10-inch-wide hole in 3 to 5 minutes. Rental rate is \$2.50 to \$4 an hour. (If your soil is very rocky, ask a general contractor if a power auger is feasible.)

A rented jackhammer equipped with a spading tip could also do the job. The jackhammer is often the tool of choice in areas of the Southwest where a hard layer of caliche lies beneath the soil surface.

If a great many holes need to be dug, consider a jeep-mounted digger. These are available for hire (with operator) in many areas of the West, at \$12 to \$18 an hour.

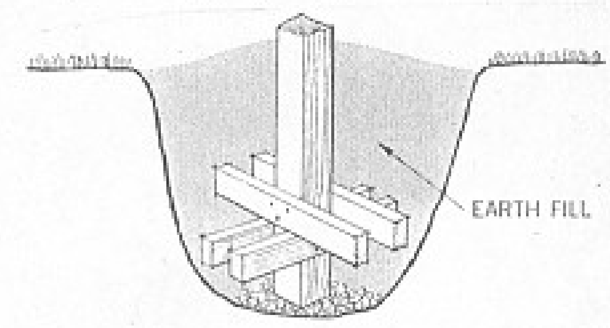
POSTS IN EARTH AND GRAVEL FILL

Where the soil is stable (not subject to sliding, cracking, frost heaving), backfilling with earth or earth-and-gravel is probably all most fence posts require.



Vigorous tamping *is key to successful use of earth fill. Rocks near top also help*

Dump in a big base stone, or a few smaller stones, or several inches of gravel, and tamp well. Set in post. Have a friend shovel in some gravel while you adjust the post until it's aligned and vertical. Continue filling with earth, earth-and-gravel, or gravel, tamping firmly every 2 or 3 inches. If the hole is wide, big rocks jammed around the post near the surface will minimize side movement. Slope the top of the fill so water runs away from the post. In light, sandy soil—which offers

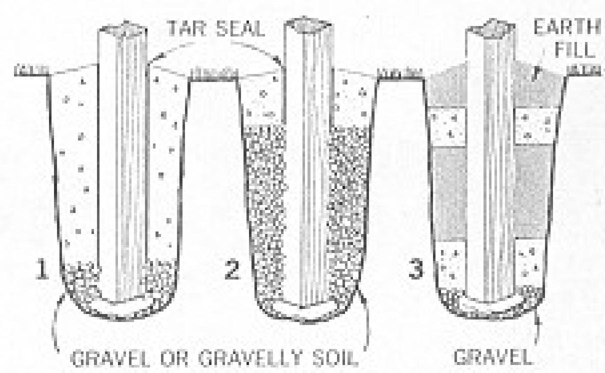


Cleats *help hold posts in very light soil*

easy shoveling but poor stability for fence posts—nail 1 by 4 cleats of heartwood cedar or redwood across the fence posts near the end.

SETTING POSTS IN CONCRETE

Concrete fill can eat up a surprising amount of cement, sand, and gravel—but it gives the strongest setting by far.



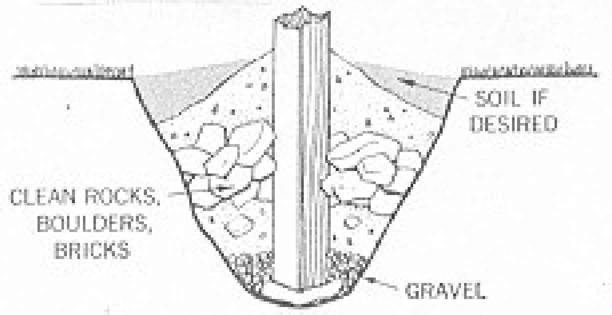
Fills *using various amounts of concrete. Types 1 and 2 are best for wet climates*

The concrete should be angled at ground line to divert water away from the post. Don't let concrete get *under* the post, where it could hold in moisture and speed decay. Above all, never set fence post ends completely in concrete.

For fence post setting, you can use a lean concrete mix, with only a third the cement needed for a walkway mix. A mix of 1 part (by volume) cement, 3 parts sand, and 5 parts gravel is good. Keep it rather dry. To extend the mix, keep a supply of washed rocks on hand, and place them around the perimeter of the hole as you pour.

Using dry concrete mixes (cement, sand, and gravel all in one bag) saves ordering time and trouble, and means you won't have heaps of leftover sand or gravel to dispose of. The usual 90-pound bag (⅔ cubic foot) sells for \$1.35. You will need 1½ bags of mix to make a solid pour around a 4-inch post, sunk 2 feet in a

 THE SURVIVOR Vol. 5



Extending concrete *with boulders reduces cost, makes solid footing in large holes*

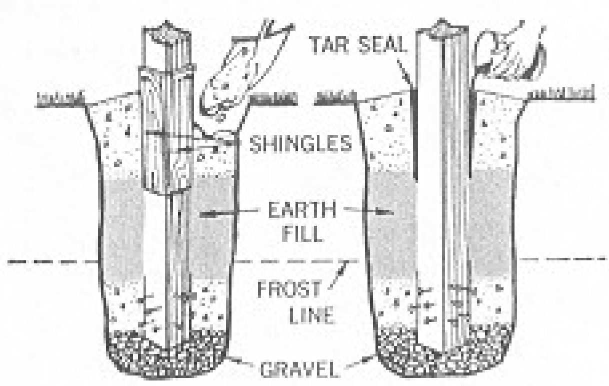
10-inch diameter hole.

Posts freshly set in concrete can be forced into a new position for perhaps 20 minutes after the pour; they should then be left alone for 2 days before boards or stringers are nailed on. During a spell of dry weather, fill the small crack between post and concrete with tar.

Frost heaving. Heavy frosts bring two problems: frost heaving, and concrete cracking.

To minimize damage from heaving, dig post holes down to a foot below normal frost line; shovel in gravel; drive nails into the sides of each post near its bottom end, and place this end in gravel; pour concrete around nail area; complete fill, using gravel or gravelly soil.

To prevent concrete collars from cracking when wet posts freeze and expand, cut shingles to width of posts, oil them, and place alongside each post before you pour. Remove shingles when concrete has set, and fill spaces with tar or sand.

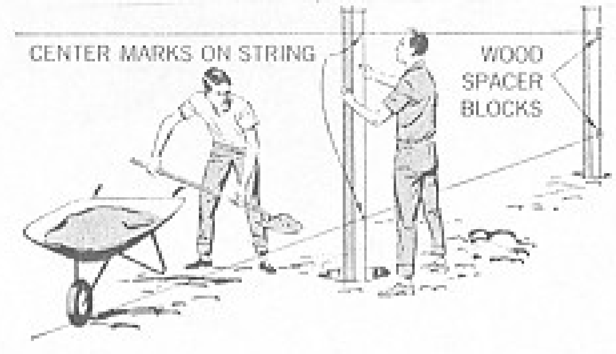


Tar *poured between post and concrete creates expansion collar, minimizes cracking*

ALIGNING THE POSTS

Many consider this one of the knottiest problems associated with building a fence. We'll describe three workable procedures among the many in use.

Corner post method. This involves setting corner posts first: firmly, permanently, and exactly vertical. Then stretch aligning strings between these posts, top and bottom. Mark points on the top line to indicate where the centers of the intermediate posts will be, and transfer the marks, using a plumb bob, to the lower



Wood pieces *keep aligning strings clear of posts, yet allow easy visual checking*

line. Set each intermediate post in gravel, with its face brushing (but not distorting) the aligning strings. Backfill carefully, checking verticals as you work.

If rough posts snag the aligning strings, slip a piece of ¼-inch material between each corner post and the strings, then nail it on. (With batter boards [see method below], move both ends of the cord ¼ inch.) Then keep each intermediate post the same ¼-inch distance from the strings.

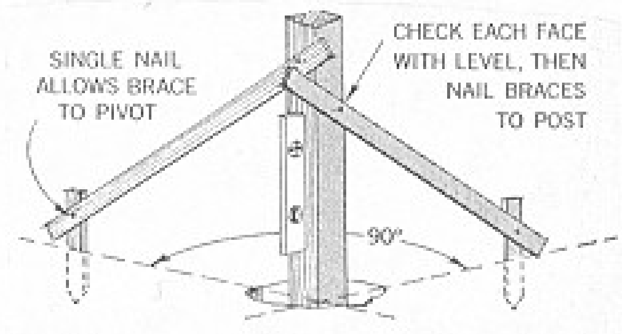
Once all the posts are in, make a final check by eye. (You can correct slight leans at this time by pushing the post and retamping the concrete or earth fill.)

Batter board method. With this method you lay out fence post locations first, then set the posts successively. Build batter boards (see diagram, page 171), and mark the intended post centers on the aligning string. Continue as in the corner post method—but this time you will have only one string to guide you, and you'll need to check verticals frequently with a level or plumb line.

Here's a tip for plumb line users: Wrap the line around a scrap piece of wood half as thick as the bob is wide. Hold this block against any top corner of the post. When the plumb line lines up with the corner edge, and the bob is brushing the wood, the post is vertical.

One-man method. The "stake-out" method makes it possible for a man working alone to align a fence. Drive two stakes into firm ground near each post, as shown below, and nail an arm to each stake. Set posts onto rock or gravel at bottom of hole, checking alignment against string. Using level or plumb bob, true one face and tack its support arm in place. Do the same for adjacent face. Check both verticals again, adjust arms if necessary, and drive home nails.

The beauty of this system is that you can stake out all the posts and give them a final visual check before backfilling.



Staking a post. *Carpenter's level held against two adjacent faces (or plumb bob on one corner) establishes true vertical*

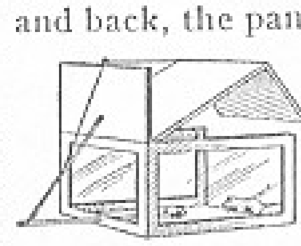
EVENING UP THE POST TOPS

Wait until the fence is finished before trimming post tops to the correct height.

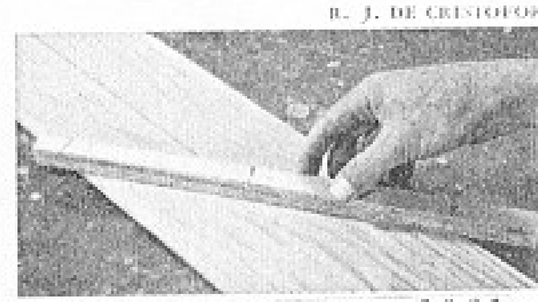
Flat post tops collect water, and this speeds early rotting. In rainy areas, a beveled or rounded top that will shed water is much preferable. If you paint the fence, lavish paint on the tops.

Popular Mechanic — 1913
Trap for Small Animals

This is a box trap with glass sides and back, the panes of glass being held in place by brads placed on both sides. The animal does not fear to enter the box, because he can see through it; when he enters, however, and touches the bait the lid is released and, dropping, shuts him in. This is one of the easiest traps to build and is usually successful.



R. J. DE CRISTOFORO



SUNSET APRIL 1961

Where's the middle?

This center-finder will work on boards of any width, up to the limits set by the distance between the outer nails. Drive a nail near each end of a 1 by 1-inch strip; center a third nail between them, driving it just far enough that a point of about 1/16 inch protrudes on the underside. File the point to a chisel shape. With the two outside nails riding the edges of the board, the center nail automatically marks the center. Slide it and it will score a center line.

CONCRETE BIRD HOUSES

will bring shyest songsters to your own backyard - -

Mechanical Package Magazine 1931

Starlings, redstarts and the shyer songbirds will build in a cement bird house.

WOODEN bird houses have had their way long enough. They are good—but not good enough for some birds. This is proven by the fact that there are plenty of birds of the shyer species which will nest in concrete houses, shunning wooden ones.

Starlings and redstarts are typical of the unusual backyard nesters that can be made your neighbors for the summer if you build a really light tight place for them—such as they have been used to in hollow trees.

To construct the mold for casting the bird houses, make four pieces of wood similar to the pattern shown in the blueprint below. This will give you a house which is a common and serviceable model, yet one which sheds rain well. The mold is cored for a vent in the top, and for a door on one side. The prints for these cores are shown.

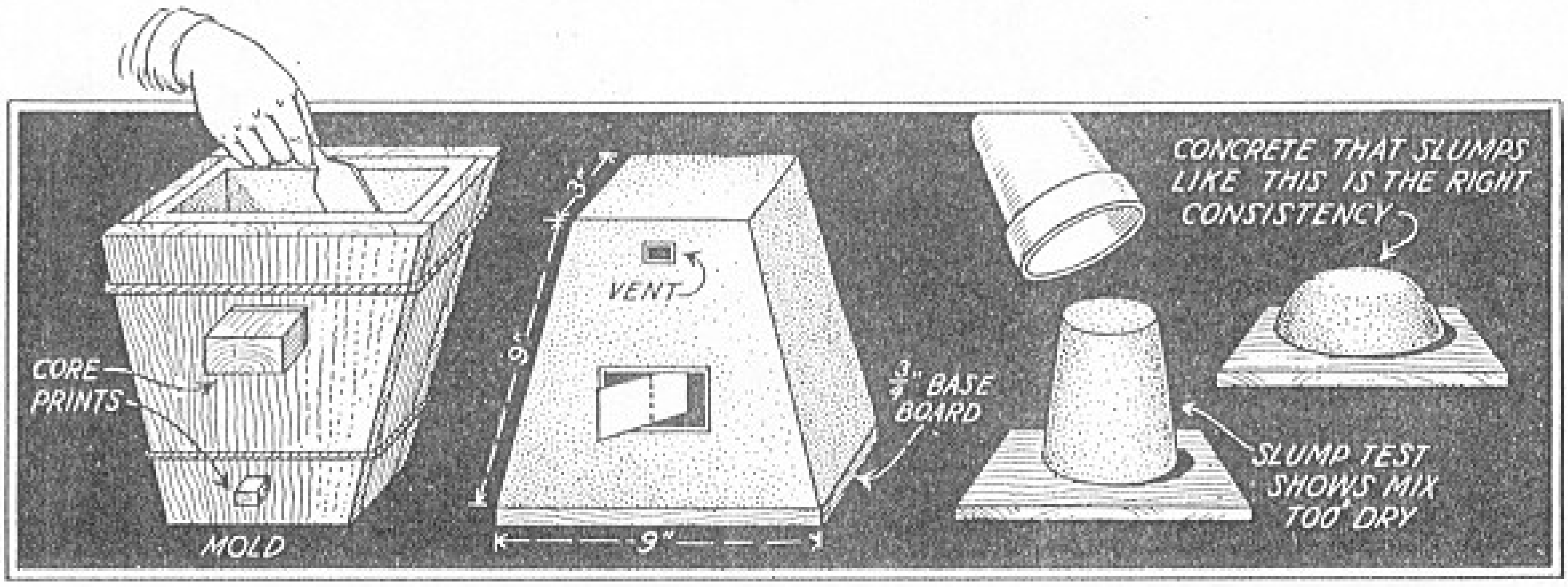
Then prepafe a concrete of 1 part Portland cement, 2 parts sharp sand and 3 parts gravel. This must be thoroughly mixed before water is added. Enough water should be added to make a moist-dry mixture which, when slump tested, will seep out into a dumpling if sloughed out of a flower pot. If the mixture stands up stiffly as shown it is too dry.

The mold, which has been tied or wired together while the cast is being made, is covered with a layer of the concrete on the bottom.

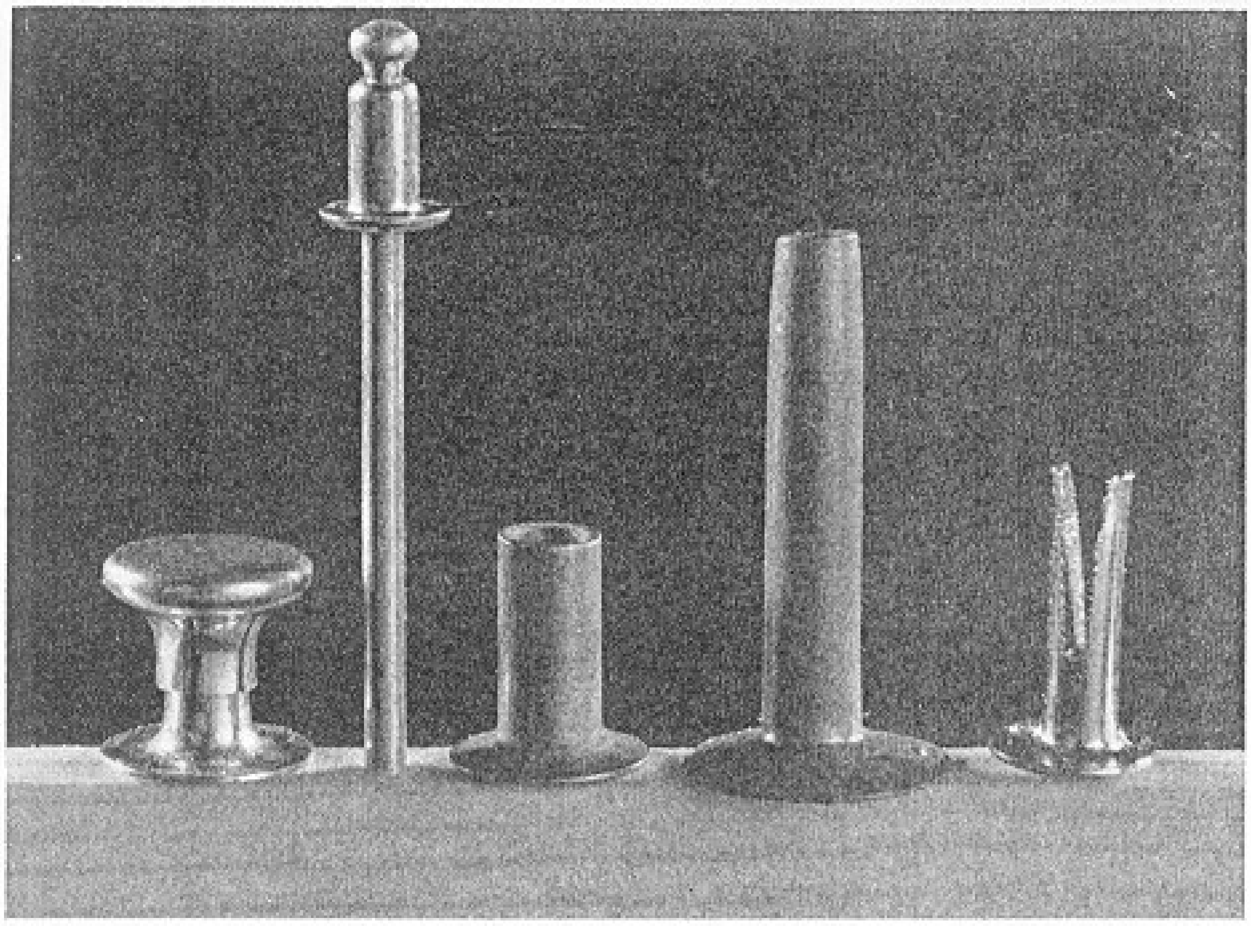
The sides are built up with a trowel. Some concrete workers prefer to make a pattern or core for the inside, and pour a rather wetter mixture than to build up the walls with a dry mixture. Either way is good.

When the top of the mold has been reached, small pieces of wood should be sunk into the concrete walls so that the bottom (of board) can be nailed on.

The opening for the birds should be provided with a revolving door, made of sheet metal and loosely mounted. The birds soon learn to enter and leave, or to adjust the door to give them just the amount of light and air they need. Of course, a vent should be placed in the top as before mentioned. It is best to mount these houses in the darker portions of trees, as the shyer songbirds frequent and nest in dark, protected places.



Certain kinds of birds prefer abodes made of concrete. This shows how the board mold is made for such a house and how to make a slump test for concrete of the right working consistency.



You'll find *these rivets commonly available today, most of them in many sizes, and various metals. From left to right: two-piece, pop-type, tubular, solid, and split rivet*

The useful art of riveting

SUNSET JANUARY 1965

Riveting seems to most of us an antiquated way of connecting things. Somehow we seldom consider using rivets when we're assembling or repairing objects around the house.

But this ancient way is often hard to beat. Rivets are very strong, never work loose, and usually make a neat job. And they're inexpensive. The cost of enough rivets to repair a lawn chair or a metal screen door is a matter of pennies.

You can find all the types of rivets shown here at a hardware store or shoe repair shop. Often you'll find the solid and tubular types in a wide variety of sizes and lengths, and in steel, brass, copper, and aluminum.

TOOLS REQUIRED

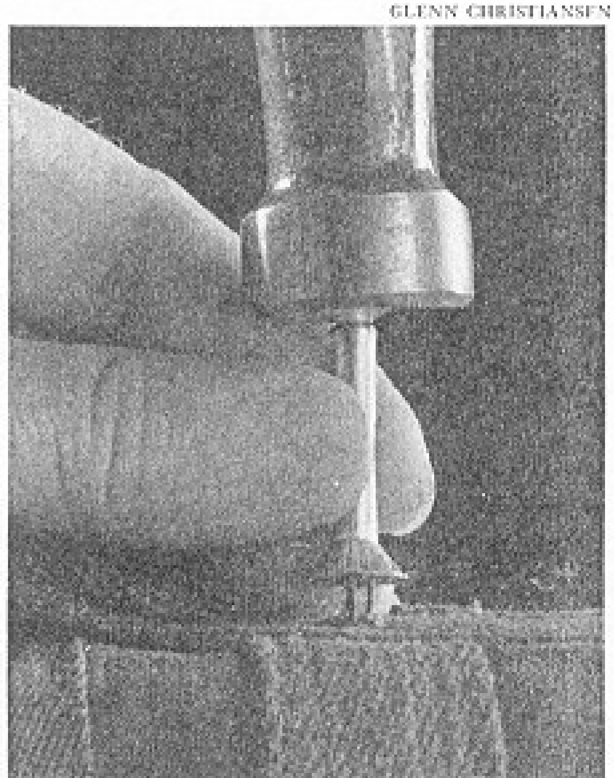
The new type of riveting gun shown on page 85 is almost as fast and easy to use as a staple gun. You can buy it at a hardware store for about $6, complete with an assortment of rivets. The pop-type rivets it uses (see diagram, page 85) come in three lengths, and will handle thicknesses up to ½ inch.

For the other types of riveting shown, only the simplest of tools are required. You'll need a bucking block, as it is called, to place under the rivet. This can be a block of steel, the top of your vise, or just the flat surface of a hammer or a hatchet.

For the split and tubular rivets, we show a rivet set being used, but it is not essential.

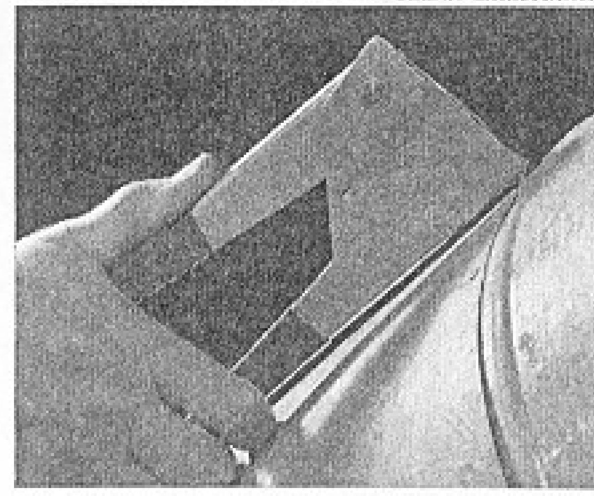
To round the driven heads of solid rivets, you can use a ball peen hammer. Simply hammer them round with light blows on top and sides. Or you can use a solid-rivet set. This is a heavy piece of tempered steel about 4 inches long, with a small cuplike depression in one end that molds the rivet's end to a round shape when you tap the set with a hammer. It costs about $2.50. The rivets' appearance will be more smooth and uniform, but the connection is no stronger.

GLENN CHRISTIANSEN



A small rivet set *(costing a dime) easily spreads apart a split or tubular rivet*

GLENN CHRISTIANSEN



Fixing *a rattly furnace pipe. You just squeeze this riveting tool on the outside*

TRICKS OF RIVETING

As the illustrations on these pages show, riveting is very simple to do. But here are some additional little pointers that may be of help:

Say you are attaching a buckle to a belt, and you want the neatest possible job: Use two-piece rivets. They come in various colors, hold well in such material, and look very professional.

When installing a split rivet in leather or cloth, don't punch a hole for it. Just drive the pointed rivet through; it will hold better. You can drive a tubular rivet, too, through soft materials.

If you are connecting two or more pieces of metal together with a solid rivet, push the pieces snugly together before you swell the rivet with your hammer. Otherwise, the rivet may swell out between the pieces, giving you a loose connection. An easy way to push the metal pieces together is to place a nut from a fair-sized bolt over the rivet, and tap the nut with your hammer. In the "working" end of a solid-rivet set, you'll find another hole for doing the same thing.

Washers are available for all types of rivets except the small two-piece ones. Use washers whenever you want the strongest possible joint in leather, cloth, and soft plastic. If you use rivets with wide, flat heads in such materials, you will need washers only under their smaller driven heads.

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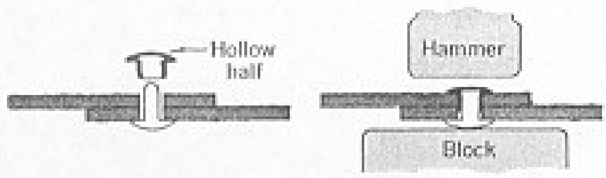
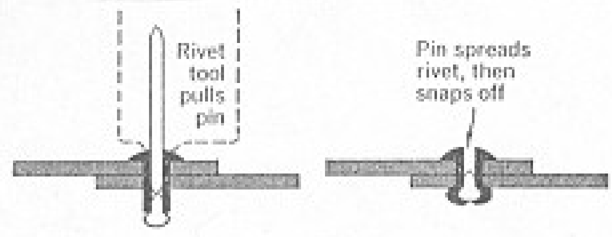
Aluminum, copper, and brass solid rivets can be countersunk easily. Smooth them with a file after tapping in place.

For metal-to-metal connections, choose a rivet that fits fairly snugly in its hole. Its end should protrude only 1 to 1½ times its diameter. If it's longer, cut it off.

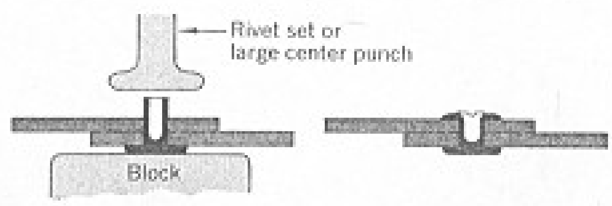
Ordinarily we think of using rivets only on canvas, leather, and sheet metals. But they can also be superior to screws or bolts for fastening pieces of ⅛ or ¼-inch plywood or hardboard together. Look at a trunk, for example.



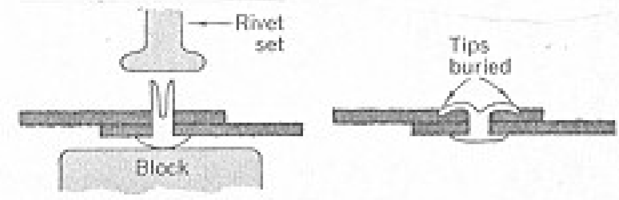
Two-piece rivets *hold well in leather and cloth. Use a bucking block, and mash in the rivet with a blow from any hammer. The result is neat, professional-looking*



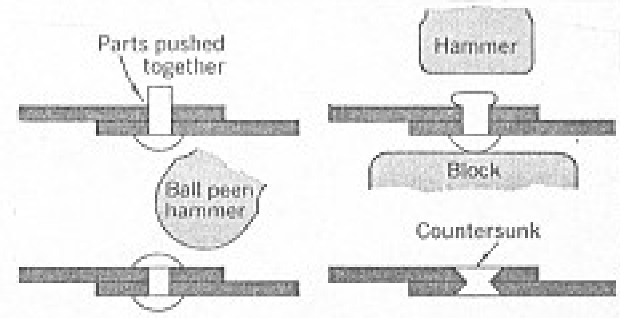
Pop rivets *also are strong in metal and plastic, and washers are available for their use in cloth and leather. They are quickly installed; no bucking block is needed*



Tubular rivets *are stronger in metal and plastic. Spread them with a rivet set or large centerpunch (with latter, final flattening is done wth light hammer blows)*



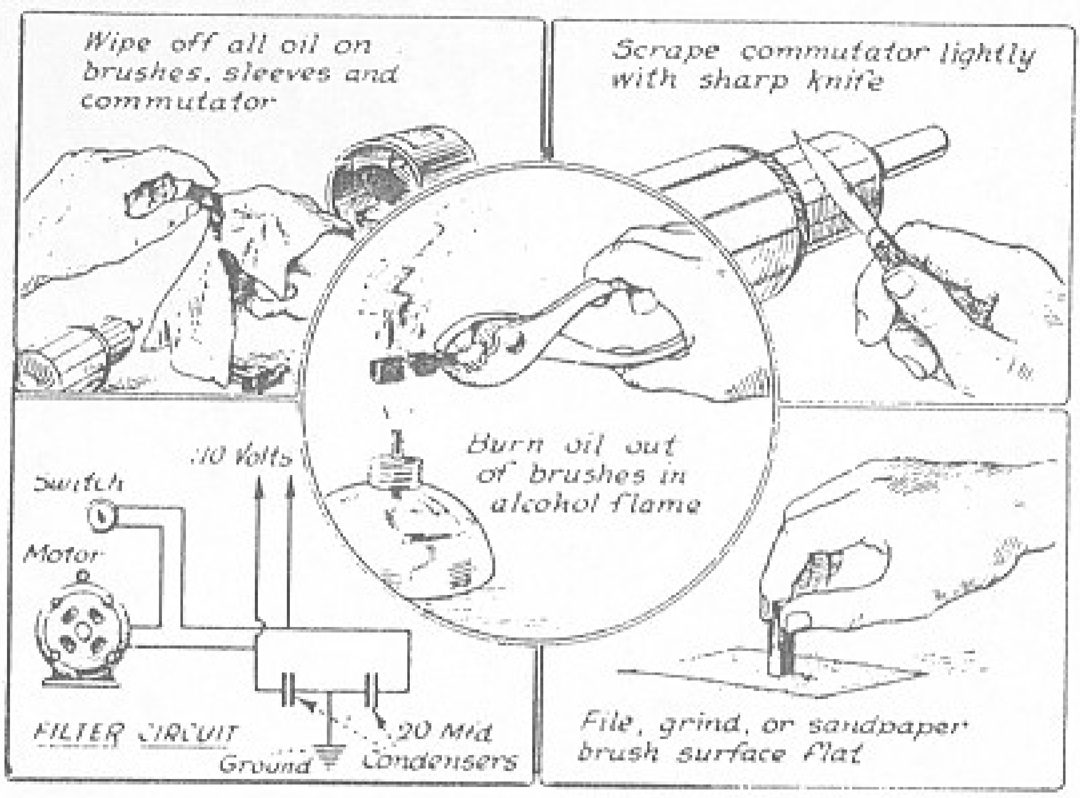
Split rivets *also hold well in leather and cloth (tips do not bury into harder materials). Use a rivet set, as here, or reverse rivet and pound tips out on block's surface*



Solid rivets *are strongest of all. You first swell the rivet in its hole, then round its head. The countersunk type can be peened in and filed down to be almost invisible*

Mechanical Package Magazine — 1932

How to Care for the Household Utility Motor



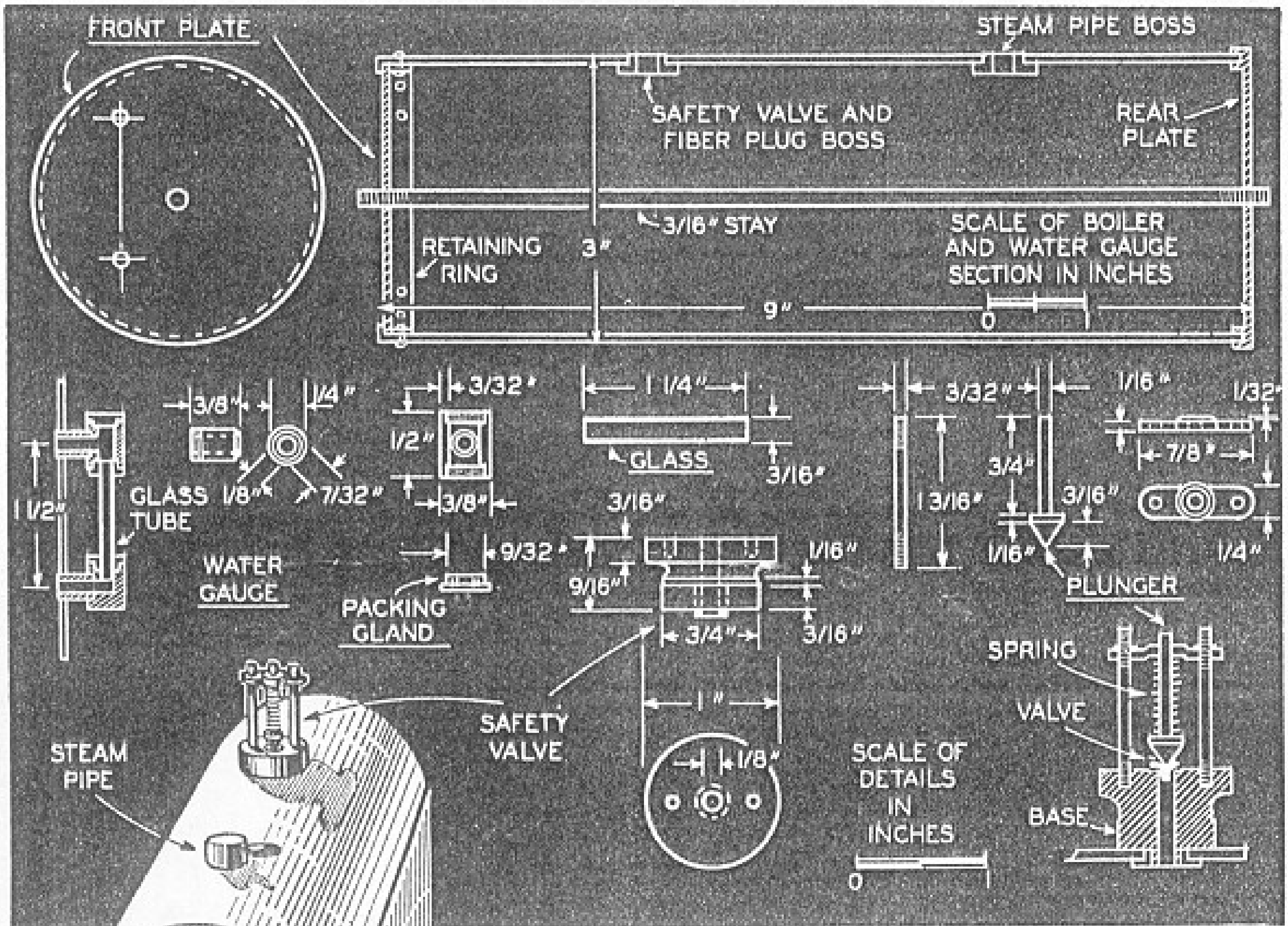
Oil in the wrong place is an enemy of small motors. Wipe off the commutator—keep it clean. Radio noises can be eliminated by grounding a 20 m.f.d. condenser across the circuit. Brushes are important. This shows how they are cleaned.

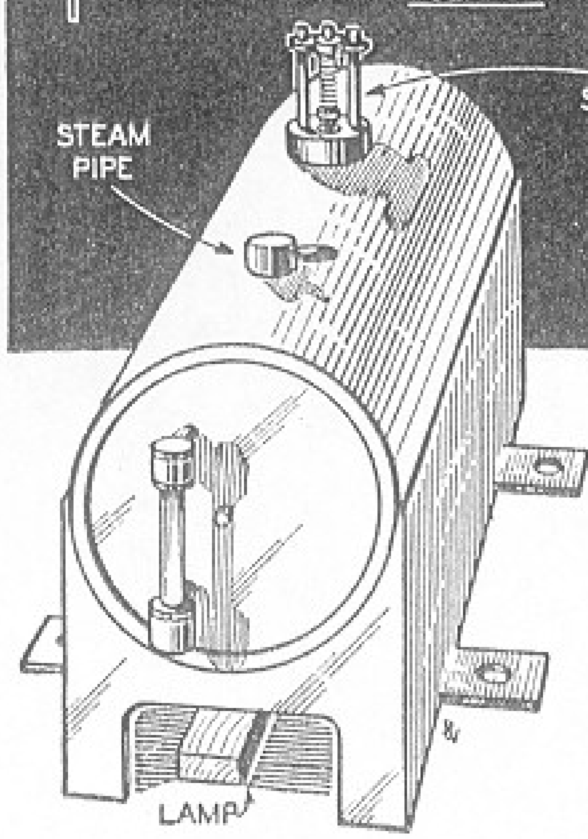
"GIVE that little mill a break," says Esten Moen, a Packmag reader. "Nothing about the household is so abused and so given to neglect." And then in these words he tells how to service the little fellows:

Usually the midget utility motor, developing only from 1/20 to ¼ h.p., is subjected to loads and lack of attention (through ignorance) more than any other piece of machinery on the face of the earth. When they get worn and growly, they affect the radio, and cause no end of dissatisfaction that is really no fault of their own but of the gentleman who runs them. Clean them up and watch the difference.

Take the end plates off. Clean the commutator by scraping lightly with a sharp knife. Do not scrape so hard that the copper comes off, just remove the scum from the burned oil. No emery or sandpaper should be used unless the commutator is badly scored. Even then it might be best to put the armature in a lathe and face it off a little.

Oil is never to be allowed on the commutator. Through ignorance sometimes people oil the whole works. Oil should be used only on the bearings. When the commutator is clean, next attack the brushes. See that they are square on the ends. When worn they are hollow and cover more segments than they should.





A SMALL BOILER
for Little Engines

Heated by a simple alcohol lamp, this little boiler will be found useful for the experimenter in powering small boats, or as a workbench source of steam.

Mechanical Package Magazine — 1931

POPULAR American magazines have neglected the experimenter who likes to dabble in miniature power engineering with the result that information on small engine designs and data on boilers to run them with are very scarce. We who make the Packmag here in the Experiment Station have cooked up this design for the model engine enthusiast, knowing it will be welcome.

The boiler has an evaporating capacity sufficient to run a 5⁄8"x5⁄8" engine. Ebullition can be controlled by the wicks of the lamp.

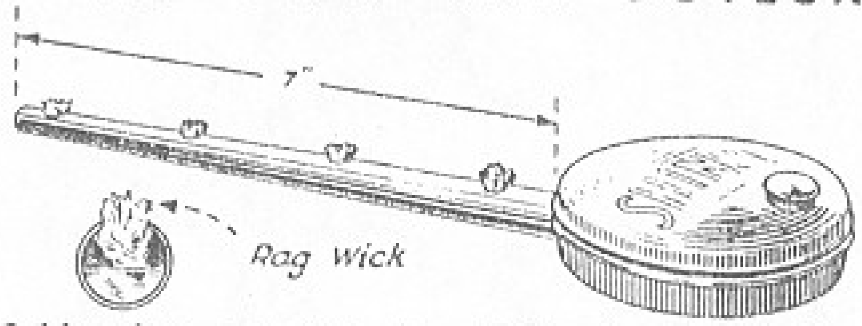
The shell of the boiler is of seamless brass or copper tubing, 3/64" thick. The rear end plate is cast of brass.

A tie rod is necessary to keep the ends from blowing, as the boiler can work to better than 60 lbs./sq. inch with safety if properly built.

The front end plate may be of sheet brass, 16 gauge, butted up against a retaining ring riveted inside the boiler.

If this construction is used, as per the drawings the end of the boiler should be rolled down around the end plate. This can be done by bearing down against the shell with a round tool-steel burnishing tool while spinning the boiler in a lathe. High speeds are used in spinning—about the same as used for wood turning.

LAMP FOR THE BOILER



Soldered up out of sheet metal the lamp looks like this. It is easy to build as here shown.

Tie rod is of brass. Two interlocked tie bolts should be put inside the ends of the plate and a bead of *silver solder* sweated to them. Never use ordinary solder in boiler work. It lets go easily and it is impossible to braze a joint on which solder has been used if at a later date you wish to increase the pressure capacity of the boiler by brazing the seams.

Next drill the shell for the bosses for the filler plug, safety valve, and steam take-off plug. The front end is drilled with two ¼" holes for the water glass. These are 1½" on centers.

You may make the valve and the water glass plugs as the drawing shows, or you can obtain them through the Experiment Station. We have contacts which can furnish you with them and also with the glass. At present a supply is coming from Germany at low prices which of course will be passed along to Pack-mag readers, as it is the purpose of our Shop to be merely a service for readers.

The lamp is made out of simple elements, being but a reservoir for alcohol with a long half-inch tube that has wicking sticking through in several places. Three or four wicks will be enough. Height of fire is controlled by the height of the wick.

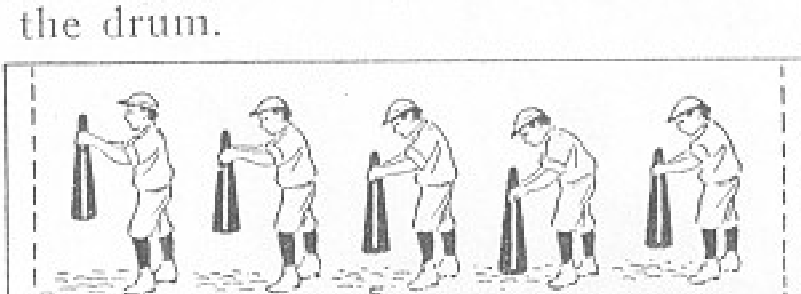
The boiler is filled two-thirds full of water and allowed to come to a full head of steam before being used. The safety valve should first be set by testing it against a known air pressure for relief. This can be done by taking it to a free air station and checking the valve blow-off tension setting against the tire gauge on the air line.

A Simple Motion-Picture Machine

Popular Mechanic — 1915

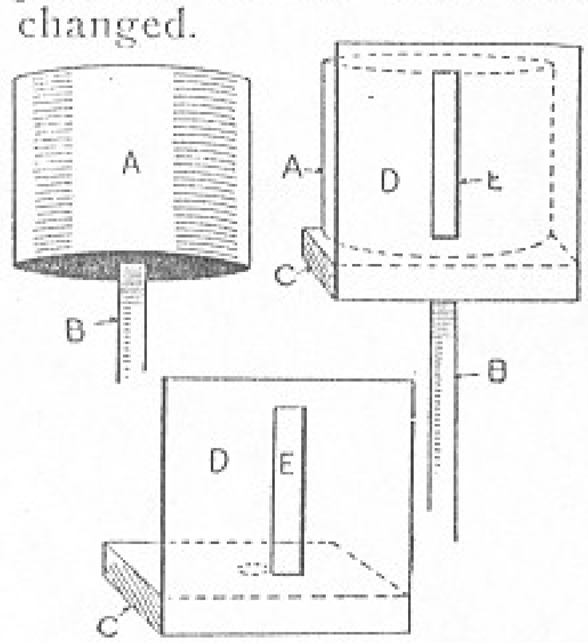
The drum A is a piece of wood, 1¾ in. long and 1$\frac{3}{16}$ in. in diameter, supported on the end of a round stick, B, which can be made in one piece with the drum, if a wood lathe is at hand, but a piece cut from a curtain pole and a lead pencil inserted in a hole bored in the end will answer the purpose. Be sure to have the diameter of the drum 1$\frac{3}{16}$ inches.

The next step is to provide the picture and attach it to the drum. A picture of a boy pounding cobblestones is shown in the sketch, at F, which should be made on a strip of paper 4⅜ in. long. This is glued or attached with rubber bands to the drum. The drawing can be enlarged in pen and ink, or can be reproduced as it is, if a hand camera is at hand, and a print used on the drum.



The Different Positions of the Picture will Appear in Action When Turning with the Drum

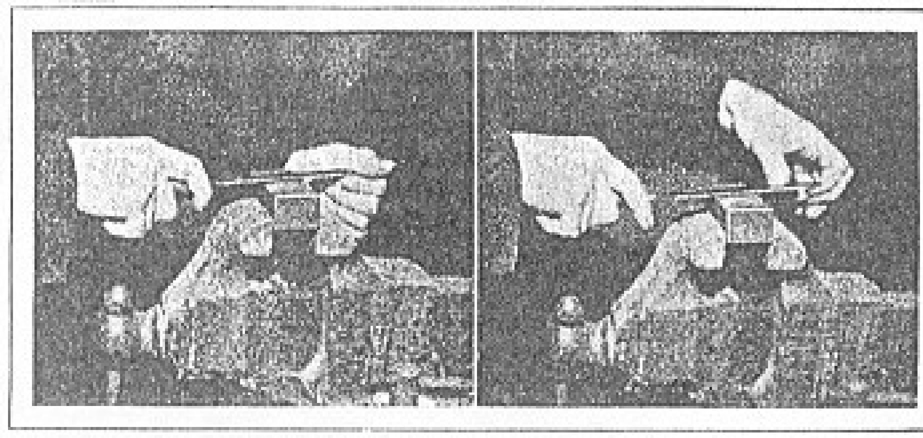
It is only necessary to put the parts together, grasp the base in one hand and turn the support B with the other, when, looking through the slot E, the boy is seen pounding the stones. Various pictures can be made and the strips changed.



The Parts for Making the Revolving Drum for Holding the Strip of Pictures

Provide a base piece, C, ½ in. thick and 2 in. square, and fasten a piece of cardboard having a slit E, as shown. The cardboard should be 2 in. wide and 2½ in. high, the slit being cut ½ in. in width, ¼ in. from the top and ¾ in. from the bottom. A hole is bored in the center of the block to admit the standard B easily.

Do You Really Know How to FILE?



The man at the bench to the left is shown holding the file properly. In the inset photos we see the reason. Left, incorrect hold; tends to round work. Right, correct grip, produces flat surface.

by R. F. YATES

The Mechanical Pkg. Mag.

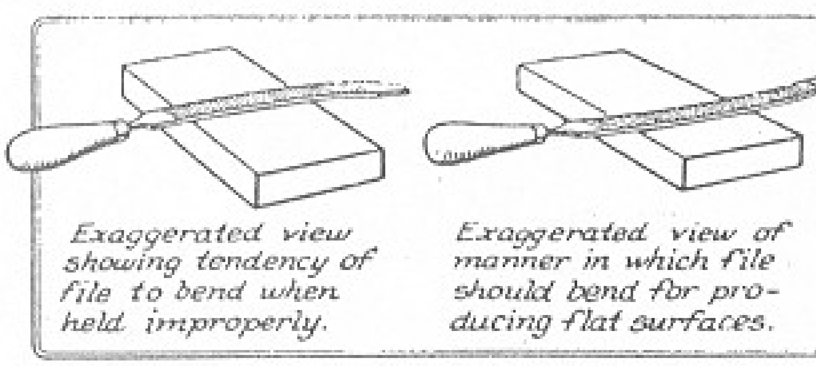
1932

TO MANY mechanics a file is just a cutting surface, that is dragged, pulled, pushed or scraped over another surface. Indeed very few mechanics fully understand the potentialities of a file nor do they have anything more than a rudimentary idea of their manipulation.

Skillful manipulation of files is attained only by experience and the best the following paragraphs can do is to describe the various types of files and the proper method of using them. Many operations can be done by an ordinary file when it is in the hands of a skilled mechanic.

Files are usually classified as rough, coarse, bastard, second cut, smooth and dead smooth. Files are also known as double cut and single cut, depending upon the arrangement of lines as will be seen by reference to the drawing. In the single cut file, all of the teeth are arranged at the same angle and run parallel, varying in different files between 60 and 80 degrees. The double cut file has two sets of teeth, each at a different angle. This point will also be illustrated in the drawing. The teeth of a double cut file are usually at an angle of 40 degrees in one direction and 75 to 80 degrees in the opposite direction.

Files are also manufactured in a multitude of different shapes and many are made for very special purposes. A cross section of all of the common shapes is shown in the sketch. Not many hardware stores, however, are doing a large enough business in files to warrant their carrying all of these types. It should be understood also that these varied shapes come in various lengths, and files of the same grade have the same number of teeth or lines per inch only when they are the same length. Thus a second cut file nine inches in length would be more coarse than a second cut file five inches in length. This is quite necessary as a bastard file four inches long would have but a few teeth upon its surface. It should also be known that the length of a file does not include its tang, which is the part that holds the handle.

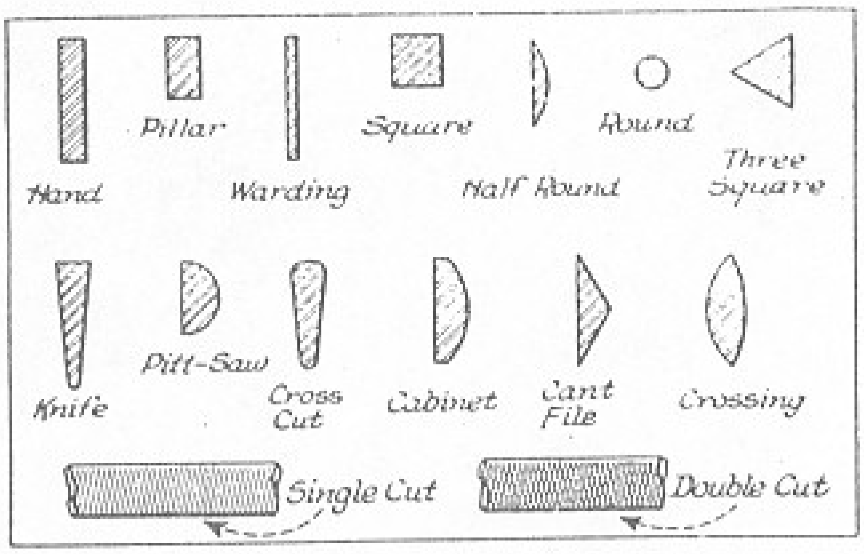


Here is an exaggerated view showing the tendency to produce a round surface when the file is held like a fiddle-bow. For flat surfaces the tool must be held flat with down spring of the left thumb.

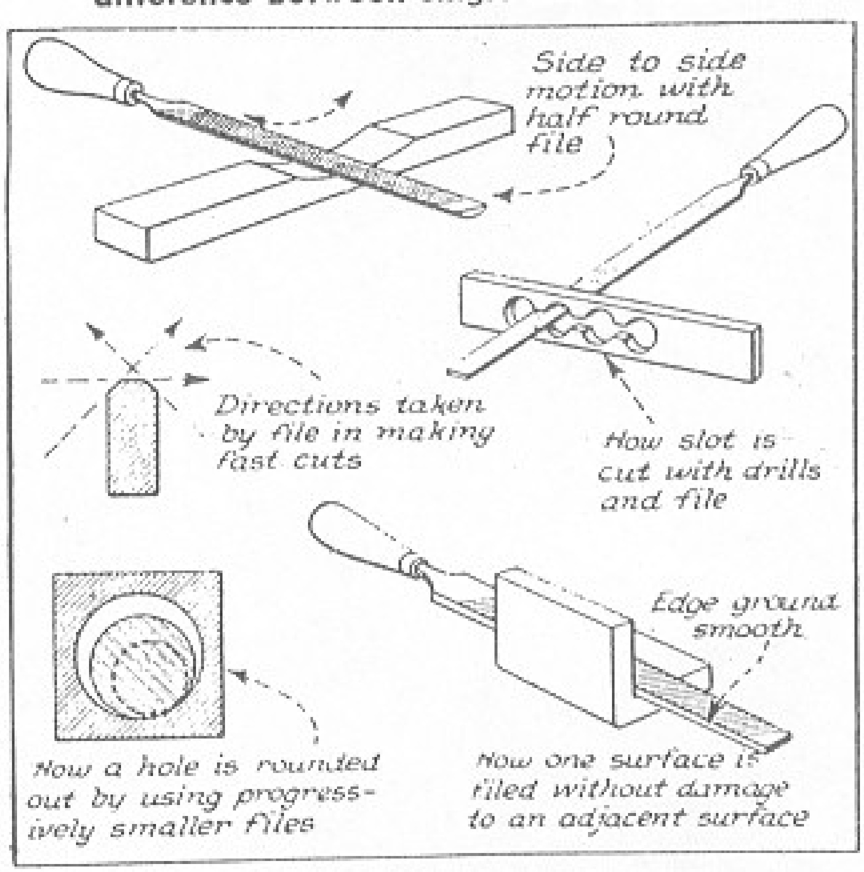
The first thing—and this may sound disgustingly elementary until we really see the point—that a mechanic should learn is the method of holding a file. A file can be used properly only when it is held correctly. In ordinary cross filing—that is filing directly across the work—a thick, medium-sized file should be used if a quick cut is wanted. When

holding a file in this manner it will be found that it can be controlled very easily and that the hands are not easily fatigued owing to the fact that it is not necessary to tighten the grip. The forward stroke should be firm and positive for this is the cutting stroke. The file does not cut on the return to the starting position. Indeed the return stroke should be very light to prevent the teeth from wearing down.

The improper method of holding a file is shown in the photograph. When used in this manner the file will have a tendency to bend as illustrated in the line drawing. Flat surfaces can be produced only when the file is



Here are cross sections of all the commonly manufactured files, with their names. All have special uses. Hand, square and round files are well known—cant and pitt-saw are used for saw sharpening. Note difference between single and double cut.



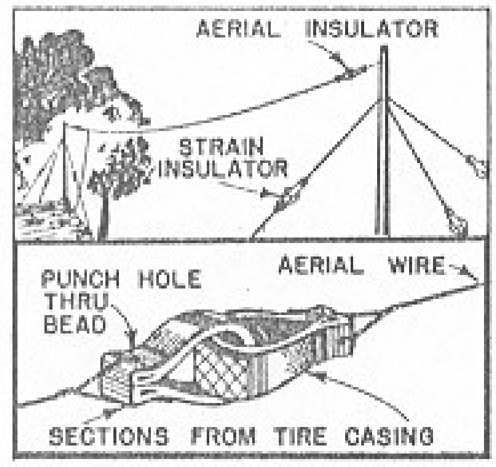
Along with the saw and hammer and brace and bit, the file is one of the topnotch necessities of the shop. Here are a few methods of effectively employing a few time-tried wrinkles in the use of this tool.

held in the manner illustrated as correct. When held in this position the cutting portion of the file becomes slightly convex and it is in this way that the flat surface is produced.

In filing a perfectly flat surface, a file with a slight belly should be selected.

Modern Mechanix April, 1935

Make Insulators from Old Tires



Make serviceable, no-cost insulators from auto tires as shown here.

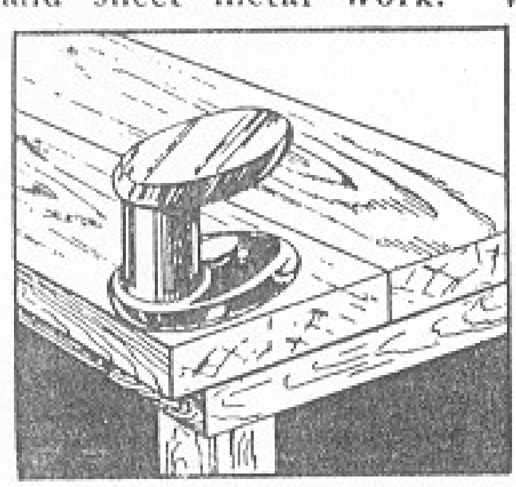
STRONG and dependable insulators for aerial wires and mast guy wires are readily made from an old auto tire casing. Cut slices about one inch wide from the casing, and punch holes in each just inside the bead. Two of these slices are looped together as shown in the sketch, and the wires then run through the holes.

A single slice slipped over a large screw hook makes a good strain insulator for tying wires to buildings or posts, as in anchoring guy wires. There is no danger of breakage here.

Mechanical Package Magazine — 1932

ANVILS cost real dough, and when the home workshop is equipped with the usual five-dollar variety it is mounted on a stump or wood block that makes it unhandy for riveting work.

A throw from an old five or seven-bearing crank shaft will make an anvil for riveting and sheet metal work. With this type of throw the cheeks are generally flat.



Crank shaft throws make good riveting anvils. Can be swivel mounted.

Here's an idea for an anvil to be mounted on the bench. It is possible to make it with a swivel mount by boring through one of the cheeks and running a locked bolt into the bench.

BUILDING A RUSTIC FIREPLACE Is EASY If You Know How

by ORVILLE GRISIER THE MECHANICAL PACKAGE MAGAZINE 1931

A FIREPLACE, before which you can enjoy the magic of the crackling flames, yet which will not destroy your better nature by belching forth huge puffs of smoke, is a joy of which we all dream.

Although the proper method of construction is not difficult — at least no more so than making one along incorrect lines—it is astounding to realize how many failures are in existence.

To build a successful fireplace it is necessary that all interior parts have certain well defined realationships to each other. These parts are shown in Figure 1. The main divisions of the working cavity are five in number; the *room opening*, the *fire box*, the *throat*, the *smoke chamber*, and the *flue*.

The exterior dimensions of the fireplace here shown are seven feet wide by three feet thick. The hearth should extend two feet in front of the fireplace.

Therefore lay out the ground plan of the foundation seven by five feet. Build the foundation up to a height three or four inches below the finish floor line of your building and level off the top.

Next construct the fire box form as shown in Figures 2 and 3. It is best not to nail too firmly in order that the wrecking may be easily accomplished after the fireplace is complete.

Center this form on the foundation with the face three feet from the rear. Square and level it and secure with braces. Build the stonework even with the top of

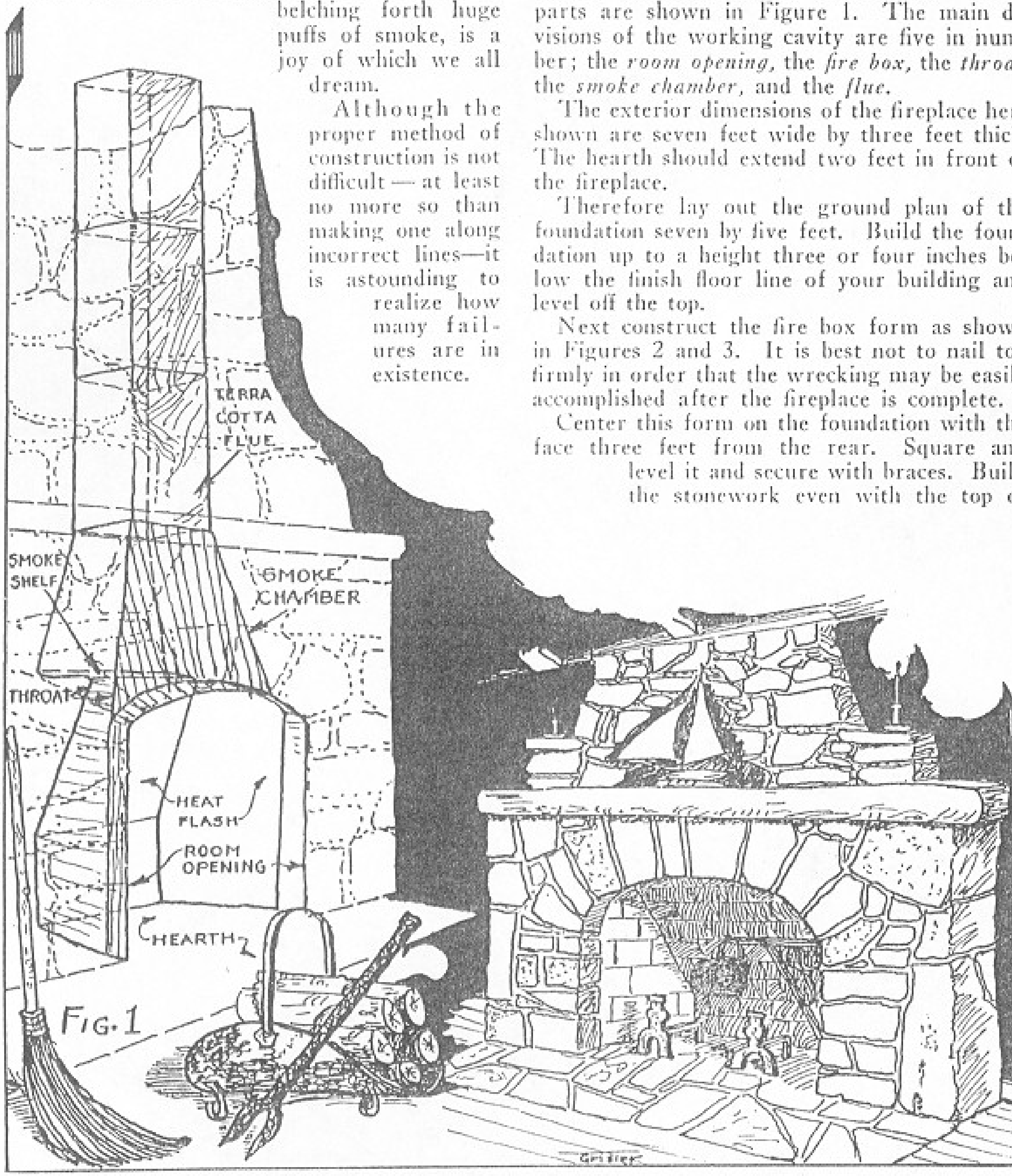
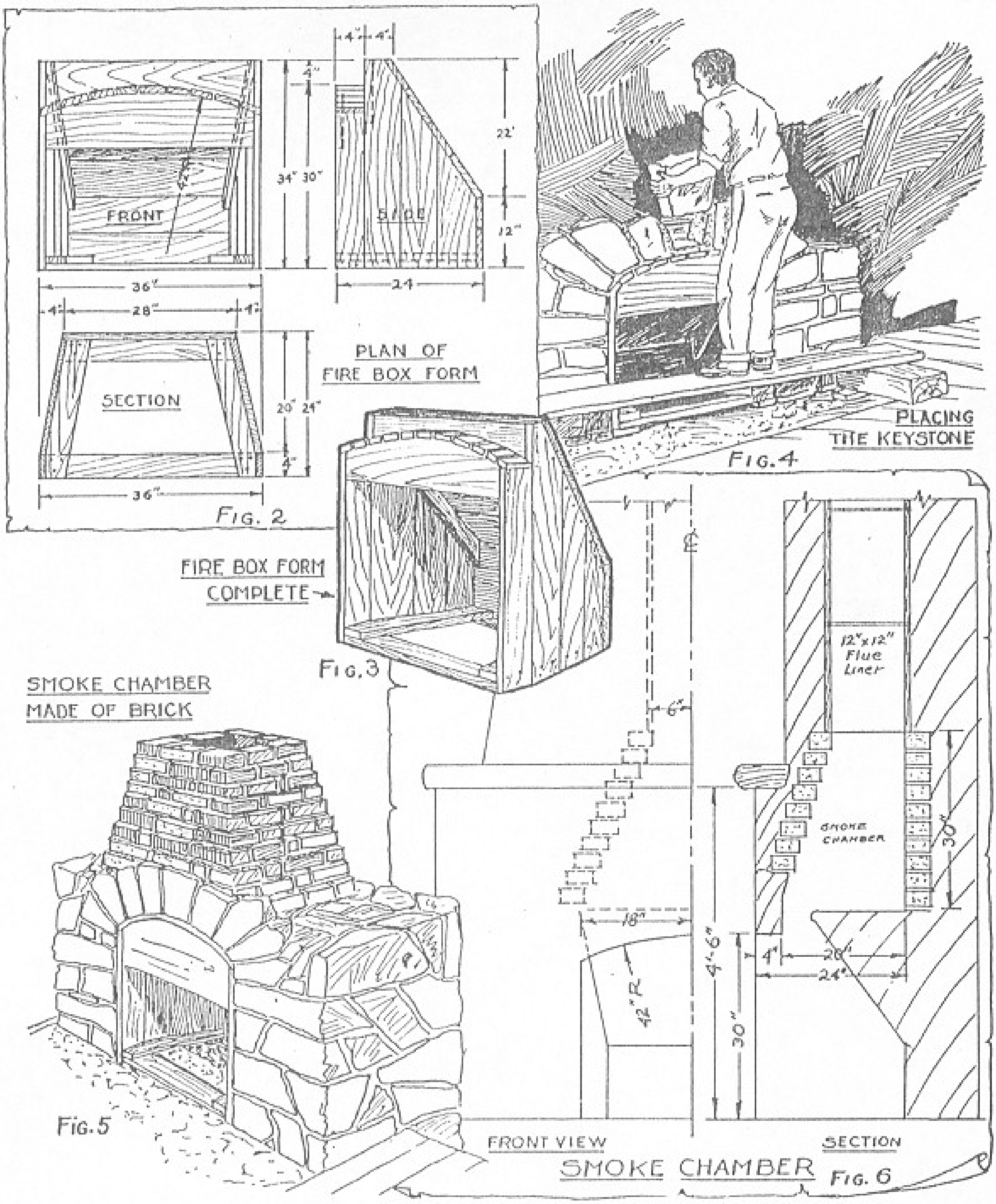


Fig. 1. This shows in perspective the main parts of a fireplace, which are: The room opening, the fire box, the throat, the smoke chamber and the flue. Mr. Grisier, a Packmag reader, has sketched his own drawings to show a pleasing rustic interior with ship model and andirons.



The main dimensions of a properly proportioned fireplace are as given in Fig. 6. A mold box is first made after the foundation for the fireplace has been laid, and the rough flagstones are built up about it. The face is laid first. Fig. 4 shows the method of placing the keystone.

the form in the rear, and complete the arch as shown in Figure 4.

The smoke chamber, which is of great importance, can then be made of brick, Figure 5. The dimensions and shape are shown in Figure 6. The back of this chamber is built straight up, while the front and sides taper in until the top opening is 12 by 12 inches in size.

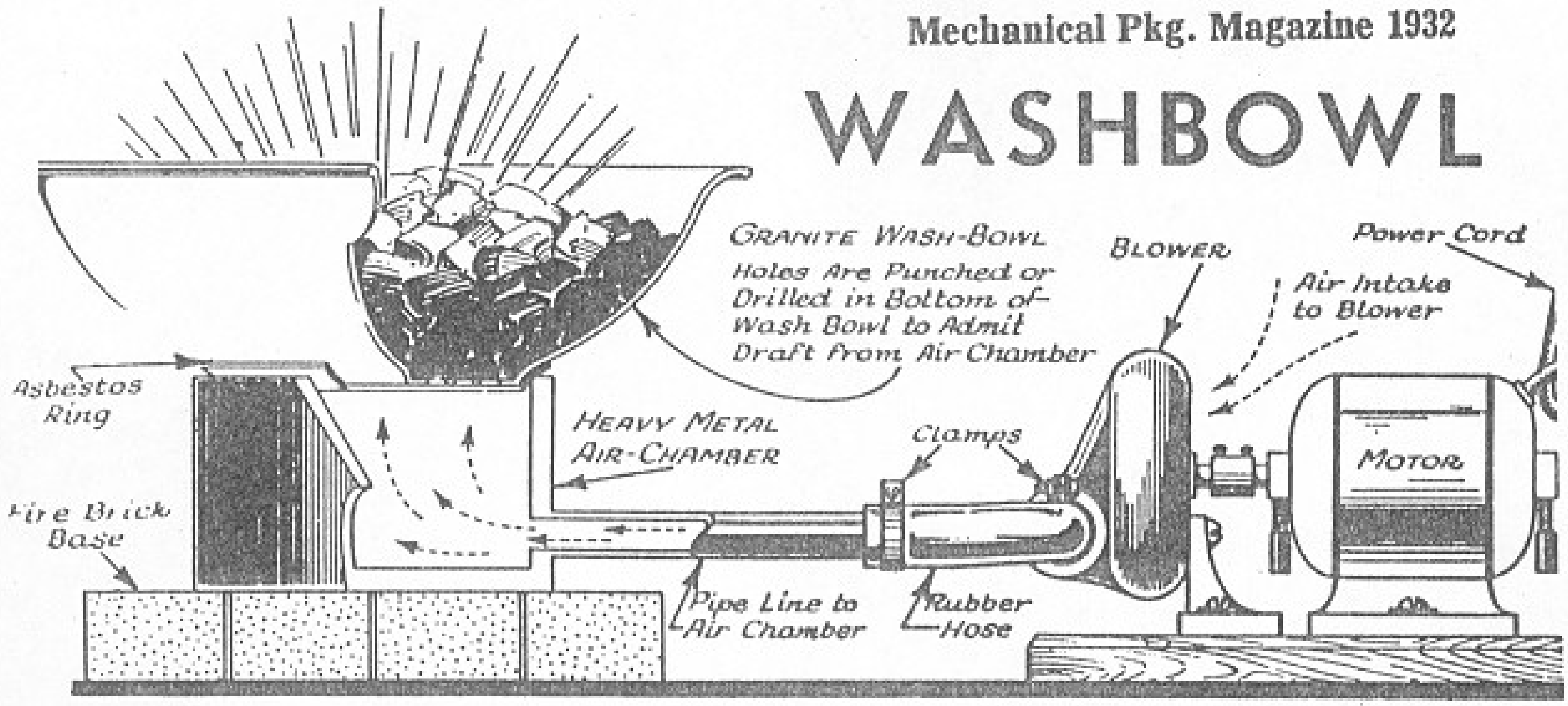
When the stonework has been completed to the top of the smoke chamber, place 12 by 12 inch terra cotta flue liner on the opening. In no case should you stop short of two feet above the highest point on your building.

By this time it will be possible to remove the fire box form, which should be carefully done. Then plaster the walls of the fire box.

 THE SURVIVOR Vol. 5

A FORGE from a WASHBOWL

Mechanical Pkg. Magazine 1932



IT IS not necessary to have an expensive forge for smithwork. Anything to heat the metal in a good hard coal fire will serve as a container and fire box.

Here's an idea recently seen in a home workshop. The forge bowl is made from a granite wash basin! A vacuum cleaner, reversed on intake and outlet to furnish draft instead of suction, with the blades trimmed to moderate the blast, was coupled to a tuyere box by a length of garden hose.

Capacity

The forge was capable of bringing small work to adequate heat very nicely. Later a steam valve was fitted to the blast intake, and the draft can now be controlled to a hair, which is necessary for annealing and for carbonizing.

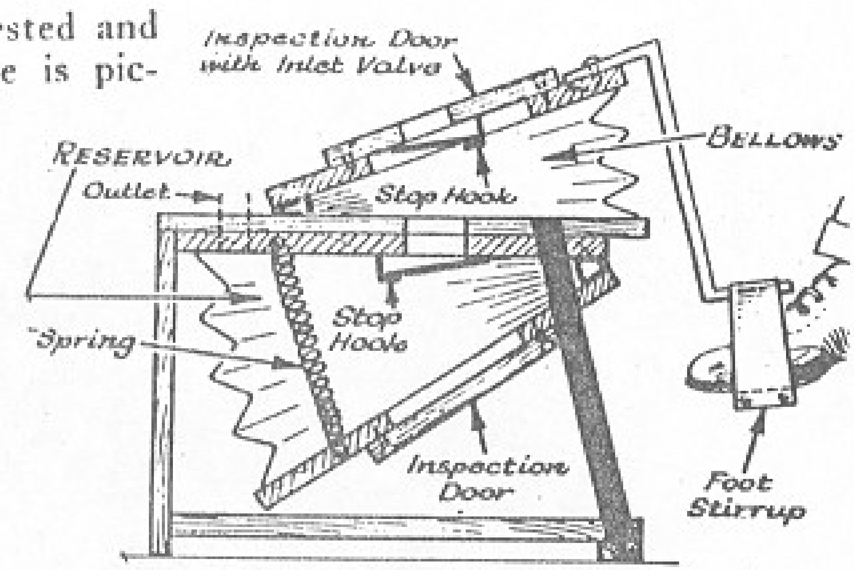
Several refinements have been suggested and the resulting simple, practicable forge is pictured here.

Draft

The other lid should have three or four holes drilled into the center in a space which can be covered by a silver dollar.

This is for bringing a small fire up, so as to heat bends and for localized upsetting. Thus with these two lids acting as tuyeres (pronounced tweers — blacksmithese for forge air vents) controlled fires can be had through the medium of varying drafts and tuyere sizes.

Take a granite washbowl and punch out the bottom so that a cast iron stove lid of proper size can be rested on the bottom. Drill 1/4" holes in two of these lids. Keep the pattern of the holes spread in one lid — this for open, large fires and general heating.



In place of the vacuum cleaner or motor driven blower, foot power bellows can be installed which will leave the hands free for manual work.

The forge should be mounted on a fire brick base. For an air chamber a piece of six-inch water or gas pipe can be cut to the proper height—could even be made as a stand, reaching to the floor. The fire brick must be under this air chamber for catching cinders. Preferably it should be demountable for cleaning.

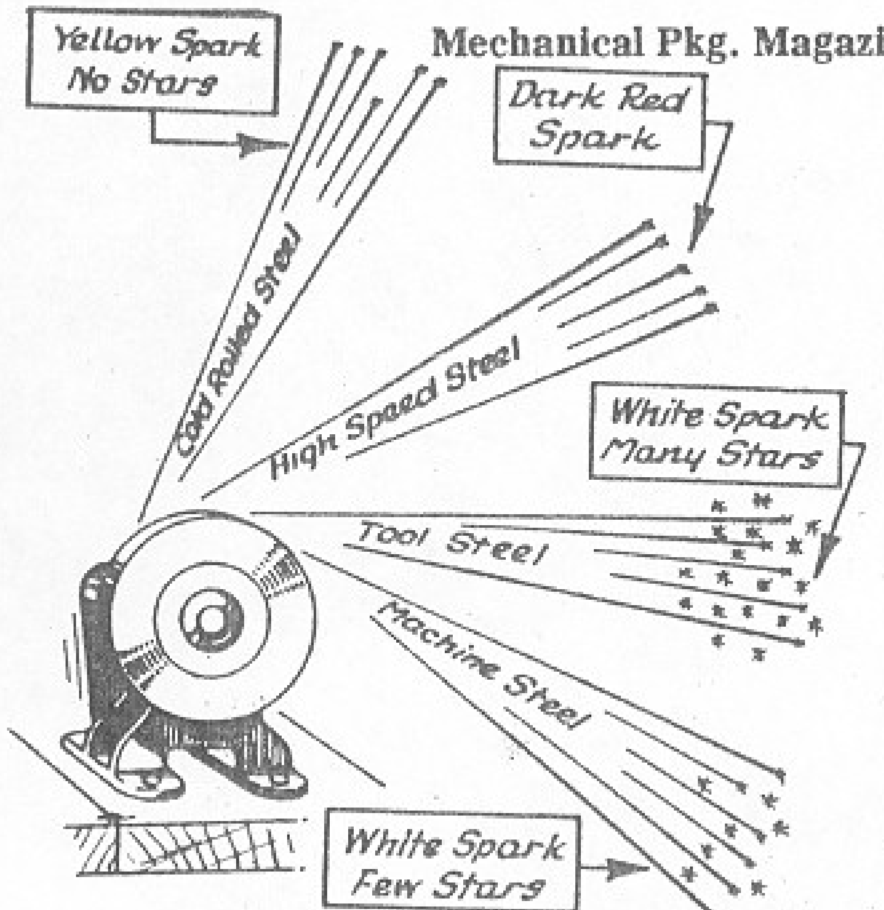
Coal

Coal for forge work can be had from any coal supply house. It varies as to locality but most of it is known as Kentucky Forge coal. This is a hard, small, very clean, semi-bituminous coal which kindles easily, burns steadily without a great deal of smoke. It can be kindled with a small wood fire. It is tempered with water to confine the fire to the desired part of the forge.

Such an addition will be welcome to the smithing equipment of any home workshop. It is cheap, adequate, ingenious.

An asbestos shield should be set up around the forge if it is to be used on a bench near a wall so as to shield the wall from cinders and sparks.

Mechanical Pkg. Magazine 1932



The most reliable empirical method of determining the kind of steel you are using is the grinding wheel test. The steel throws off characteristic sparks as above.

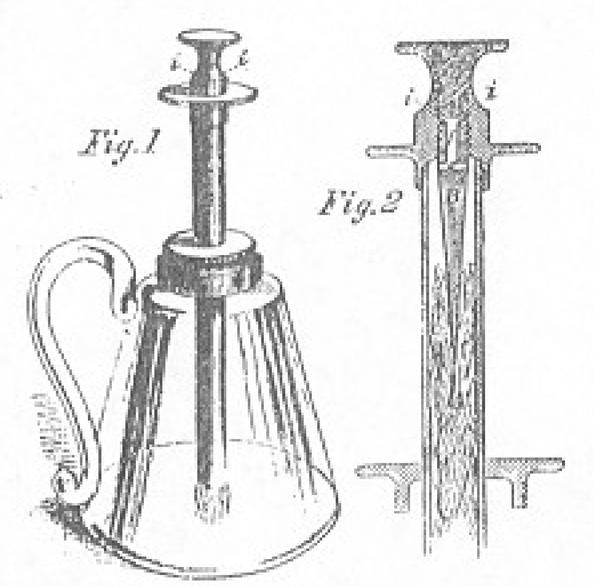
STEEL can be definitely analyzed in rather a rough manner by testing its grinding qualities on an emery wheel. Each steel used in shop work—high speed steel for lathe tools, cold rolled steel for shafts, machine steel for dies—has a special sparking characteristic and grinding color. This is more definite than the method of noting its cutting color in a lathe, or of noting how it cuts.

These four fundamental steels show the greatest contrast in the color between high speed steel and tool steel. High speed steel throws off a red spark that does not break into a star, which is characteristic of all steels which have tungsten in their make-up. Tool steels having a carbon content ranging from .8% to 1.8% throw off a white spark that breaks into a star. The length of the spark denotes the high or low carbon steel. That is to say, the higher the carbon the shorter will be the spark before it breaks into the air. The drawing shows the main differences to be noted in determining steels by grinding colors.

GREENE'S GAS LAMP.

Scientific American — May 1860

The inventor of this lamp is a physician who discovered that he could make more money by selling patent rights than he could by practicing medicine, and as, according to the testimony of Louis, Jackson, and all the most learned masters of therapeutics, there is scarcely anything positively known in regard to the treatment of disease, the doctor considered the negotiation of these sales as more useful and honorable, as well as more lucrative, than the dealing out of doubtful doses. He accordingly obtained an agency for the sale of patent rights of Clayton & Bailey's gas lamps; but improvements soon occurred to him, and he invented the lamp here illustrated. He is now located in Boston, doing a dashing business, having, as he says, sold over $20,000 worth of his lamps during the last three years, and is making a vigorous effort to introduce them all over the world.



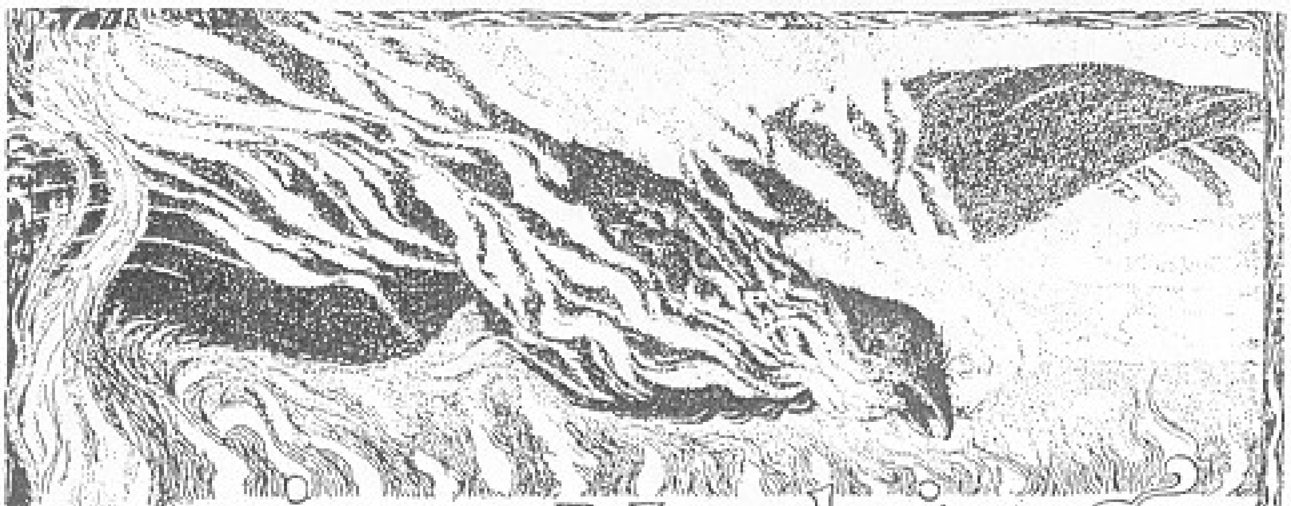
The lamp is designed for burning the common mixture of alcohol and camphene, called burning fluid. It is very simple, and will be readily understood by inspecting the cut, in which Fig. 1 is a perspective view of the whole lamp, and Fig. 2 an enlarged view of the wick tube. The wick, A, extends downward into the fluid, and upward nearly to the top of the tube, where it is pierced by the solid metallic spur, B. Directly through this spur, is the hole, *e*, which communicates with the vertical hollow, *f*, and this with the inclined openings, *i i*, which are extended also through the tube, forming jets for the escape of the vapor or gas which is burned as it issues. The lamps are made of various illuminating powers by simply varying the number of these orifices. The heat of the spur evaporates the fluid which is conducted to it by the wick, and thus a constant flow of vapor is caused to issue from the jets.

The patent for this invention was taken out by Dr. C. A. Greene, April 21, 1857, and further information in relation to it may be obtained by addressing Dr. C. A. Greene & Co., 34 Washington-street, Boston, Mass.

Popular Mechanic — 1913

Venting a Funnel

When using a tight-fitting funnel in a small-neck bottle, trouble is usually experienced by the air causing a spill. This can be easily remedied by splitting a match in half and tying the parts on the sides of the stem with thread.—Contributed by Maurice Baudier, New Orleans, La.



Fire-Making.

By H. L. Jerome. Drawings by Otto Bacher.

Should you find yourself in the wilderness without a match, how could you obtain fire?

St. Nicholas — April 1899

THE devices that are in use among uncivilized men for getting fire are interesting. It is a curious fact that the African, in lighting the fire in which to smelt the iron from which he makes his remarkable steel weapons, uses neither stone nor metal in obtaining the first spark. It is interesting to observe the fire-making tools that have been used. They may be divided by the sort of motion required into four classes. Indians, Australians, Eskimos, Hindus, and others use the whirling or drilling motion. Malays, Burmese, and others use a sawing movement. Polynesians, Papuans, and others use a plowing motion, while the custom of obtaining fire by striking a light seems now as common among barbarous as civilized men. In nearly all tribes several methods are used, according to circumstances and the means at hand. A very fine collection of fire-making implements may be seen in the National Museum in the Smithsonian Institution at Washington. Nearly every method is represented there.

The simplest and probably the oldest and most widely used device is called the two-stick apparatus. It has been used everywhere and at all times. It consists of a rough plank or large stick, which rests on the ground, as a hearth, and a smooth, round stick, from one and a half to two feet long, which we will call the drill. In the gradual improvement of this simple but necessary tool the different tribes show their mental development — their ingenuity or power of thinking.

The wood chosen for the hearth is dry, worm-riddled pieces of the juniper, white maple, or cedar. Drills are also chosen of dry inflammable wood. Many tribes prefer the starchy stem of some flowering plant.

The hearth has one or more — usually many — holes or shallow sockets drilled in its upper face, and narrow slots leading from these sockets or fire-holes to the tinder beneath. The tinder is made of shredded bark, or fungus, which will catch fire quickly and burn slowly, like a slow-match.

Soft, corky wood.

An Indian kneels with one knee on each end of the hearth, which is of a convenient length, and placing an end of the fire-stick upright in one of the sockets, or fire-holes, twirls it rapidly between his open palms by rubbing them back and forth past each other almost to the finger-tips. At the same time he presses the drill firmly into the fire-hole, letting his hands move down the drill until they nearly reach the bottom, when they are brought back to the top with a quick, deft motion, and move swiftly down again. Soon you will see that the wood is being ground off the end of the fire-stick in a fine powder that collects in the narrow slot leading from the fire-hole to the tinder beneath. As the amount of powder increases, it grows darker and darker, until it is almost black. You will notice the odor of burning wood, and after the stick has been twirled from fifteen to forty-five seconds, a little curl of queer-colored smoke will begin to arise. Combustion has begun. The Indian will then tap his wooden hearth, and the smoking pellet will drop out of the slot to the tinder below, where it can easily be blown into a blaze.

It is necessary to keep the fine, friction-heated dust in a close heap if fire is to be generated from wooden tools.

The Quinaielt Indians of Washington Territory used a drill which tapers at each end. This makes the downward pressure more firm, and does not allow the hands to slip down too rapidly. They used a slow-match of frayed and braided cedar bark, which could be lighted at one end and carried for many days under the blanket if carefully protected from wind and rain. The slots in their hearth are broader, which allows the dust to collect in larger quantities before dropping below.

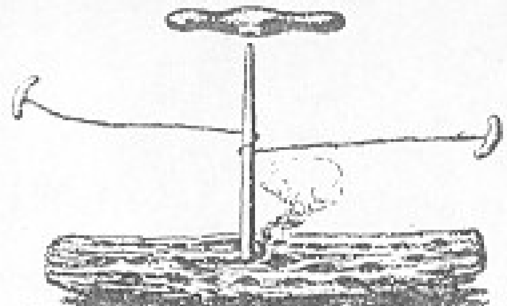
Some tribes make their fire-making tools more inflammable and more easily ground away into combustible powder by charring the drill in the fire. Sand is often used to increase the friction. This method of making fire was sufficient for its time, for it was seldom necessary to make a new fire except as a religious ceremony. The art of fire preservation was at its height. Mr. James Mooney reports that "the Cherokees kept fire buried in the mounds upon which the council-houses were built, so that if the house was destroyed by enemies the fire would remain for a year or so."

Some tribes use a hearth rounded and tapering at each end. The fire-slot widens toward the bottom, so that the pellet in dropping may have draft. The hearth is made of soft wood, while the fire-stick is made of the hardest wood obtainable, and is pointed with resin.

The Hupa Indians of California use a hearth-block of hard wood, and a drill of soft wood which has been charred on the grinding end. It is much easier to start a fire with a fire-set which has been for some time in use than with a new one; and therefore the set is usually in the care of the most skilful fire-maker, who wraps the parts carefully with long, narrow strips of buckskin, and keeps them beneath his blanket where they will not become damp.

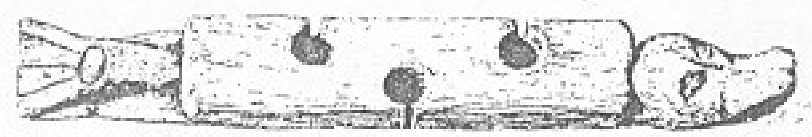
An Indian takes great pride in being a quick fire-maker. Captain J. G. Bourke, U. S. A., reports having seen the Apaches secure fire with this simple apparatus in eight seconds. Under the most favorable conditions the Apaches claim to be able to make fire with a series of motions that occupy exactly two seconds. If this can be done, the Apache is the most skilful fire-maker on record. One can scarcely strike a match in less time.

Many tribes can produce fire in less than forty-five seconds; and nearly all tribes resort to many devices, using flint and steel at one time, the fire-drill at another, or, if unable to obtain either of these, they can produce a spark by rubbing one dry branch up and down



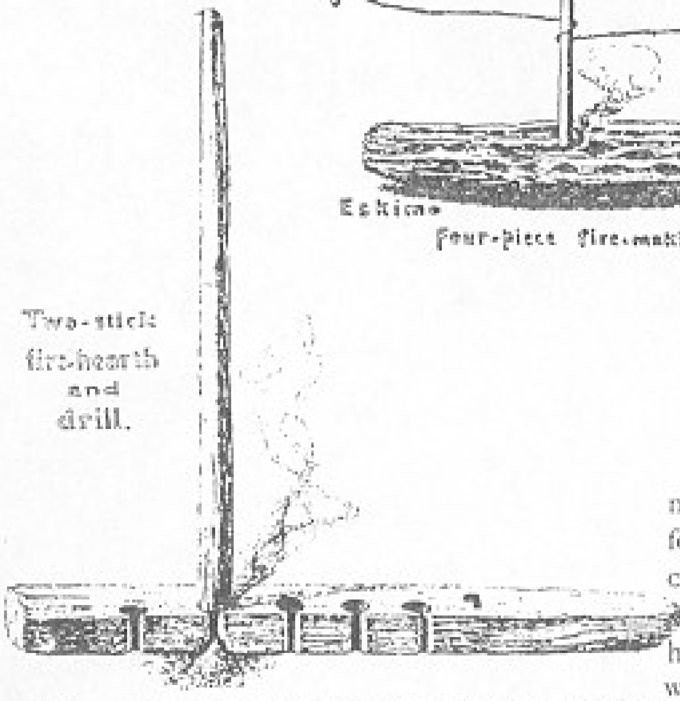
Eskimo four-piece fire-making set.

Fire-hearth



Fire-hearth and drill.

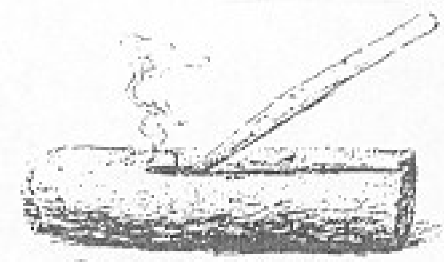
Two-stick fire-hearth and drill.



another. In some tribes the fire-making is considered women's work, beneath the dignity of a warrior, and left wholly to the squaws; but Mr. H. H. Johnson, the well-known explorer, reports that in some parts of equatorial Africa, where the usual methods of fire-making are much the same as in those tribes where this is the peculiar task of the women, the art "is the exclusive privilege of the men. The secret is handed down from father to son, and it is never, under any conditions (or so they say), revealed to women." When asked the reason of this, the natives replied: "If women knew how to make fire they would become our masters." In southern Africa the hearth is a log; and the Africans are so much less expert with the fire-drill that the whole strength of two men is often exhausted in producing fire. One man whirls the stick until both hands have descended almost to the lower end, then the other man begins at the top and continues the movement while his companion waits to relieve him in the same way. The second man also keeps the dust close to the point of the whirling stick, and gently blows it into a flame at the proper time. The African's clumsiness in fire-making, and the fact, before referred to, that he does not use the products of his forge to strike a fire for its lighting, is one of the interesting and curious anomalies of savage life.

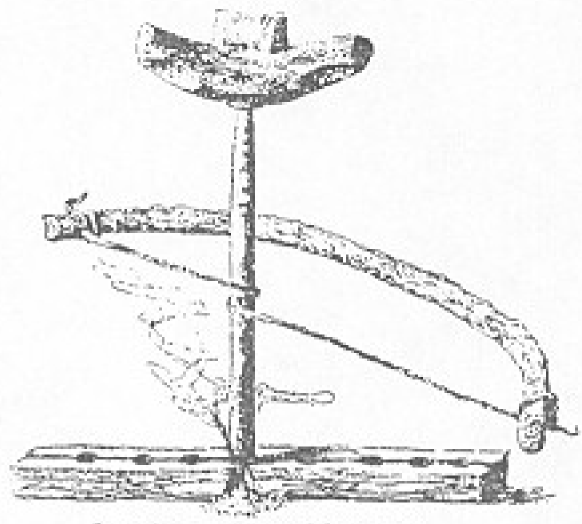
The Eskimo has added a curious feature to his fire-drill The drill and hearth are in most ways very similar to those already described, but he whirls the drill, instead of between his palms, by the aid of a cord which makes one turn around the drill at about the middle of the stick. This cord is usually made of the rawhide of a seal or other animal, and it is tied at each end to a handle cut from a hollow bone, or fashioned out of a bear's tooth or a bit of wood. In order to keep the stick in place in the shallow fire-hole it must be held at the top; therefore there is a fourth piece of apparatus necessary. This fourth piece is usually a flat, straight bit of bone or ivory, in which a socket is made to admit the upper end of the drill, as will be explained.

When one man is to make the fire this top-



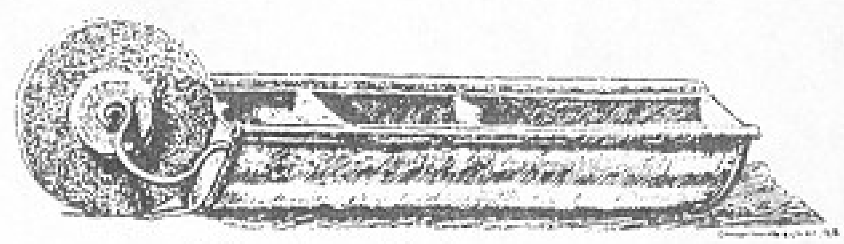
Plowing Method—hearth & fire-plow from Pacific Islands.

AFRICANS USING THEIR FIRE-MAKING APPARATUS.



Four-piece fire-making set Showing bow-drill, mouth-piece & hearth.

Deer-skin tinder-bag.

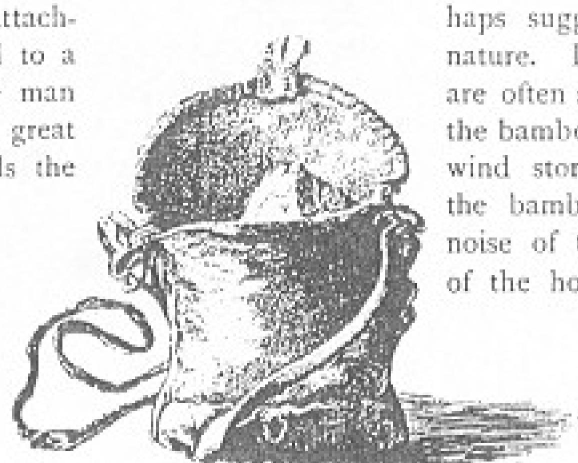


Wheel tinder-box.

piece is held between the teeth. A civilized man can scarcely endure the jar on the jaws and head produced by whirling a stick thus steadied by a block held between the teeth. Among the Eskimos it is seldom necessary for a man to make fire alone. It is a matter in which all have an interest, and two men usually make it together, each pressing the top-piece with one hand and each holding one end of the whirling cord with the other.

The top-piece is sometimes merely a block of wood, ivory, or bone, but is more often elaborately carved to resemble a seal, bear, whale, or walrus. The upper part is raised to form a good grip for the teeth, and many of the specimens in our National Museum are chewed in a way that shows the power of the Eskimo jaw. When the piece is intended for an assistant to hold in his hand, it is larger and has no teeth-grip. In the under part of the top-piece there is a cup-shaped hollow set with some stone having antifriction qualities. These stones seem to be chosen for their beauty. They are mottled, striped, or beautifully ringed. Against this inlaid stone in the hollow the top of the fire-drill rests and revolves easily.

An improvement on this four-part fire-drill is the attaching of the whirling cord to a bow. This enables one man to whirl the stick with great rapidity, and if he holds the top-piece between his teeth or against his breast (when it is made broad and of convenient shape), he can start a fire or drill a hole easily alone. The bow is evidently an improvement on the handled cord, and is an ingenious idea. These bows cannot easily be carved, as are the top-pieces; but, true to his passion for elaborate decoration, the Eskimo makes the bow of the gracefully curved ivory tusks of the walrus, and, after working them down, covers the surface with the most lively and graphic engravings of the reindeer, whales, seals, and bears he has killed, or with a picture-history of his hunting and fishing expeditions.



The hearth is especially adapted to the snowy home of the Eskimo. Should the heated pellets of powder fall through the slot to the ice-covered ground they would never ignite. The Eskimo, therefore, cuts steps in his hearth so that the pellet will fall to the lower step. Some hearths have a central hole to which the slots from the other fire-holes lead. At times the central-hole hearth and the slot-and-step hearth are both used in the same tribe. The Eskimos also have "fire-bags" made of sealskin, and often embroidered with excellent needlework, in which to carry the drill and the tinder so that they may be kept very dry. The down of the arctic willow is used as tinder. The use of these sets for fire-making is probably secondary. They were undoubtedly used primarily for boring holes in wood and bone. When used for boring, the drill is tipped with flint or bone. The mouthpiece usually has a hole in one end through which a cord can be tied to secure it to the other pieces, so that in moving it may not be lost in the snow.

Fire-making by sawing was perhaps suggested to the Malays by nature. It is said that jungle fires are often started by the rubbing of the bamboo stocks together in high-wind storms. "The creaking of the bamboo is indescribable; the noise of the rasping and grinding of the horny stems is almost unendurable" during these storms, say travelers.

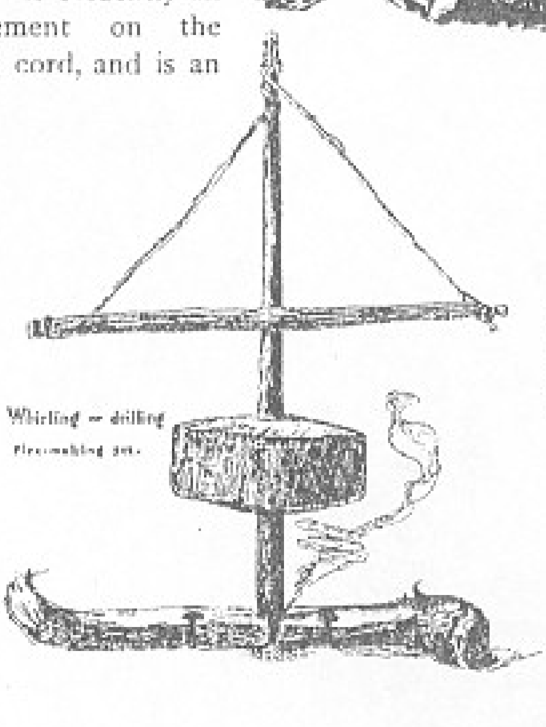
However the method may have been suggested to them, it is a very simple one. A piece of bamboo having a sharp edge is rubbed across a rounded piece in which a notch has been cut. The Malay saws across until the hollow convex piece is pierced. The heated particles fall below and ignite. Some Malays "have improved on this by striking a piece of china, tinder being held with it, against the outside of a piece of bamboo, the silicious coating of the latter yielding a spark, like flint"; but the sawing knife is more commonly used. Sand is sometimes added to increase the friction. In some places, when the particles fall they are gathered in a dry leaf and swung around the head until the leaf blazes.

The plowing method seems to have sprung wholly from the Pacific Islanders. It is closely connected with the sawing method. A soft, corky bit of wood is picked up near by, and a small, pointed stick of hard wood is found. Kneeling on the hearth or soft stick, the man holds the pencil-like plow between his clasped hands, somewhat as one takes a pen, and forces it forward at an angle of about forty degrees, slowly at first and then with increasing rapidity until the wood is ground off and forms in a small heap at the end of the groove he has so made. The groove is about six inches long. Mr. Darwin found it difficult to make fire in this way, but at last succeeded. The Samoan can get fire in forty seconds, and some can make the wood burst into flame by this method.

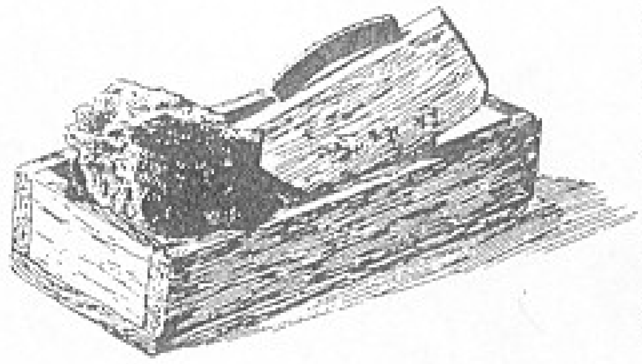
The fourth method of obtaining fire — that of "striking" a light — is one familiar, in a degree, to all. Before steel was obtainable, flint and pyrites were used. Eskimos of the Mackenzie River district use a fire-set composed of a tinder-pocket, which contains tinder made of down from the willow catkins mixed with charcoal, or soaked in gunpowder and water, a rough bar of flint, and a half-sphere of pyrites, evidently a round stone broken in two for greater convenience.

The tinder-bag is made of reindeer skin. A little bag hanging from the larger one contains tinder to use in case that in the larger one becomes accidentally useless; but the little bag also acts as a toggle. It is passed under the belt when the tinder-bag is carried by the squaw, much as our women wear their chatelaine-bags. The cover of the bag is an oblong pad stuffed with deer hair. This pad is held on the forefinger under the pyrites to protect the hand when a spark is being struck off into the tinder in the bag.

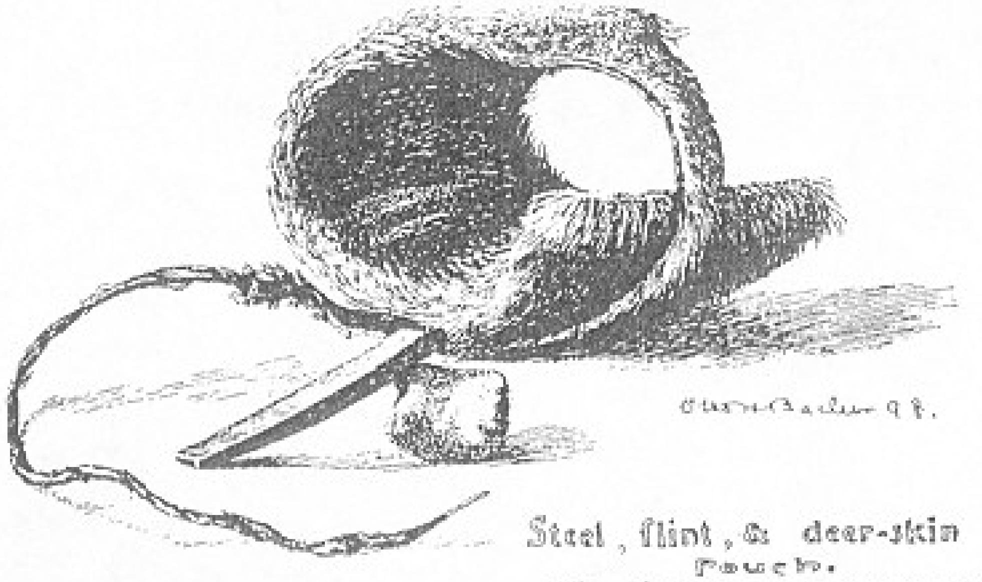
With the Iron Age came the use of the flint and steel, and the most ancient specimens of these fire-making tools are so nearly like those found in many an old garret to-day that description seems unnecessary. Various devices



Whirling — drilling fire-making set.



Japanese steel, mounted in wood, flint, & tinder-box.



Steel, flint, & deer-skin pouch.

were invented to improve the common strike-a-light. One of these was the wheel tinder-box. The wheel was spun by sharply pulling a cord which had been wound around its projecting axle, much as one spins a top. The flint was pressed against the whirling wheel, and a shower of sparks fell into the tinder within the box. The pocket strike-a-light is still used by the peasants of France for lighting their pipes.

The Chinese strike-a-lights show a very ingenious way of combining the steel with a pouch in which to carry the flint and tinder. In Tibet the pouches are often elaborately trimmed with incrusted silver set with costly jewels.

The Ainos of Japan have a particularly convenient fire-set. The shoe-shaped steel is fastened with a piece of sinew to the cork of a wooden bottle containing the soft charcoal used as tinder. Besides the small piece of flint, there is also a curious fire-stick which burns like a slow-match for a long time, and a pouch of twined and woven rush in which to keep these articles. "The Aino takes out the cork with the steel attached, and stirs up the tinder with the sharp point. He then holds up the flint in his hand over the box, and strikes a spark down into it. He transfers the coal to his pipe, or material for fire, or fire-stick, with the point of the steel."

The Japanese still use flint and steel. Their tinder-boxes have two compartments. The smaller one is for the tinder and has a damper. The larger one is for the flint and steel. They mount the steel in wood.

Our North American Indians were slow to acknowledge civilized arts and methods as superior to their own; but fire-making with flint and steel appealed to them at once, and was promptly adopted. Buckskin pouches were made in which to carry the flint and steel, and hung from the belt beside the tomahawk. They have many curious beliefs concerning fire and its origin. The Alaskan Indians will tell you that "Yetl," the Great Raven, who created man and gave him all blessings, after obtaining light and fresh water, stole a burning brand from a fire island (volcano) in the sea, and started back to earth holding it in his beak. But the journey was so long that the brand burned shorter and shorter. Swiftly and more swiftly Yetl plied his magic wings; but the brand burned his bill, and then dropped to the ground and scattered in all directions. And because the divine fire, dropped from Yetl's beak, entered into every rock and every dry bit of wood lying on the surface of the earth, they say one can always call fire out of the rocks by striking them with steel, or out of wood by rubbing it with other wood.

This is the Alaskan explanation of the mystery known to us as fire-making.

POPULAR MECHANICS

April 19, 1902.

HOW THE EARTH'S HEAT MAY BE USED FOR POWER.

The Thermo-Electric couple, when perfected, may solve the problem of utilizing heat from the center of the earth as a source of power, mentioned in the last issue. In Cassier's Magazine it is stated that if the couple can be made to generate power to run large enterprises, a hole similar to an oil well could be drilled into the surface of the earth a mile or more and the instrument, with the attached wires, lowered until the heat was sufficient to give the desired amount of energy.

The principle of the thermo-electric couple is simple. When a change of temperature occurs at the junction of two slips of dissimilar metals an electric current is excited in them. Many inventors have endeavored to turn that phenomenon to account. Clamond built up a hollow cylinder out of alternate layers of tin and an alloy containing antimony and heated the interior with a gas flame formed around a perforated earthenware tube. Harry B. Cox of Hartford has constructed a somewhat similar battery, which may be run with a gas jet and left alone for a month at a time. The Postal Telegraph tested it and fonud that it would work a telegraph wire. These and other thermo-electric batteries, however, have thus far failed to generate currents cheaply, but it is hoped that experiments still in progress will lead to the discovery of the valuable secret. The possibilities it holds out, such as giving us heat, power and light from the earth's center, are so great as to cause many of the present day to look upon it as incredible.

HOW MAPLE SUGAR IS MADE.

Lillian C. Chase of East Fletcher, Vt., gives the following interesting description of the process of making maple sugar in her state:

It is an industry that will surely become extinct unless something can be done to preserve our maple trees or make it worth while to raise and nurse sugar orchards with the same care given fruit orchards.

A good "run" of sap means toil night and day while the sap lasts, though we seldom "boil" the whole night, as we were obliged to do before we had modern conveniences. We tap the trees, making a half-inch hole, and the sap drops into the buckets. It is emptied into large tubs fastened to sleds and drawn to a covored building, in which are evaporators. The sap flows constantly into one end of a corrugated pan and is drawn out at the other end as sirup, ready for the market or to be made into sugar. This sirup is then placed in a large pan over another iron arch, like that for evaporator, and boiled till thick enough to grain. It is dipped into small pans while boiling hot and stirred with wooden paddles till well grained, then poured into the molds or tubs.

Most of it is made into two-ounce cakes. Each cake has to be lifted from the mold to cool on all sides. Then the edges are trimmed with a knife and they are packed in different-sized boxes ready for shipping.

The quality of maple sugar varies with the season, the very first and last being the poorest. The color depends principally on the care of the makers in straining the sap and sirup to take out the "nitre," a sandlike sediment which is always present. The best maple sugar is a light brown color about the shade of sandpaper.

Electricity Direct From Coal

By Dr. William W. Jacques
Harper's New Monthly Magazine — December 1896

This process worked, as shown by the figures. It was energy efficient and produced far more than it used.

The process was abandoned due to the growing boom in petroleum production. As far as I know, it has been lost since then.

Experimenters would do well to build a small pilot plant to prove it out. Even if successful, it would not help the big picture, as new developments will take too long to implement in time to avert the collapse. But you might at least set up a system to light your community.

A LUMP of cannel is burning on the grate. What takes place? The air is drawn in beneath the grate and rises through the bars. Its oxygen combines with the coal to produce carbonic-acid gas, which, together with the inert nitrogen of the air and the smoke or unconsumed carbon, rises in the chimney and escapes. This is the rôle played by the *materials*. How about the *forces*? The chemical union of the oxygen with the coal sets free the coal's stored-up energy, and this energy, being indestructible, must manifest itself in some way, and so shows itself as *heat*. This is the whole story of combustion.

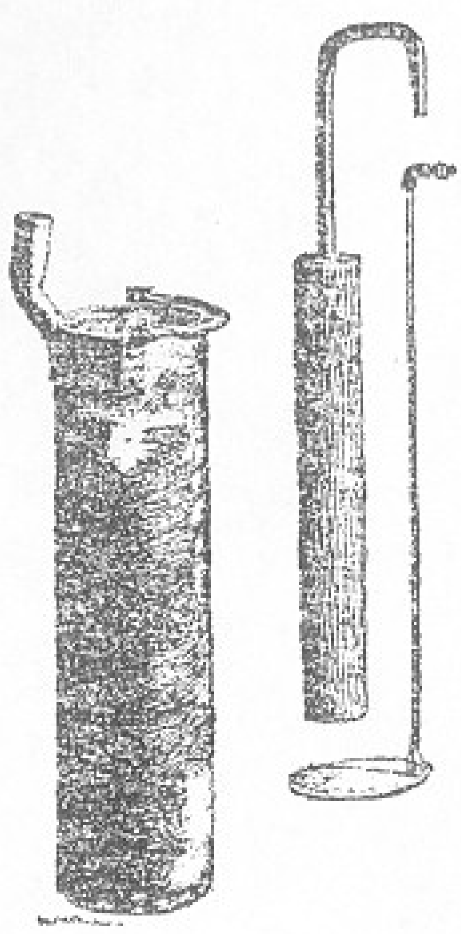


FIG. 1.—AN ELEMENTARY CELL,

Taken apart to show iron pot, stick of carbon with iron suspension, and air-supply pipe with rose nozzle. This carbon is twenty inches long and ten inches in circumference, and yields a current of about one hundred and fifty amperes. The electro-motive force is one volt.

Sitting before an open fire I have often dreamed of converting the stored-up energy of the coal into some form of energy even more useful to man than heat. We know that, theoretically at least, all of nature's forces are interconvertible; why should not the potential energy of coal be converted directly into electricity instead of into heat? Could all of the energy be extracted from a single pound of coal and made to do mechanical work, this work would more than equal a day's labor of a very strong man. In the great coal-fields that are distributed over the surface of the earth nature has stored up a supply of energy safely estimated to equal the hand labor of the entire population of the world continued for a thousand years.

The most convenient and useful, because the most tractable, form of energy is electricity. In the facility with which we may at will and without waste convert it into such other form of energy as happens to be desired lies the superiority of electricity over all the rest of nature's forces. Having electricity, we may easily produce heat or light, or mechanical motion, or chemical force; but electricity itself has hitherto been produced in quantity only by the use of complicated mechanism and with great waste.

Electricity is to-day generated by a dynamo that is turned by an engine which is operated by steam, and the steam is made from water by means of heat derived from the combustion of coal. But this is a long and circuitous process, with a large leakage at every step. Much of the energy of combustion goes up chimney as heat or smoke; much of the heat is lost in boiling the water to make steam; much of the expansive force of the steam is wasted as it escapes from the engine; much of the power of the engine is wasted as friction; and there is some loss in the dynamo itself. Recent tests, made by a committee of the National Electric Light Association, of eighty modern electric light and power plants, show that the average plant wastes 97.4 per cent. and utilizes as electricity only 2.6 per cent. of the energy theoretically obtainable from the coal.

The problem then was to convert the energy of coal more directly into electricity; to do away with the dynamo and the steam-engine; possibly even to do away with heat itself.

A multitude of experiments were made. In the earlier days my attempt was merely to do away with the dynamo and with steam, and convert heat into electricity. A fire of coke, burning on an insulated grate, gave some slight electrical manifestations, but they were not encouraging. Experiments with various novel forms of thermopile were tried, but a consideration of the theory of the subject soon made it evident that it was not even theoretically possible to convert more than a very small percentage of the energy of the coal into electricity in this way. The generation of electric currents by alternately heating and cooling the magnetic cores of wire coils gave no promise of efficient results. I tried nature's plan of producing lightning—the evaporation of water and continual dissipation of vapor globules—and though I succeeded in producing miniature thunderstorms, the quantity of electricity obtainable was not sufficient for any commercial use. Indeed, my researches have led me to doubt whether the total energy of a good brisk thunderstorm, dramatic as is its display, is equal to the energy radiated from a bedroom fire. For a minute fraction of a second the force of a stroke of lightning is terrific, but its duration is so brief that, even if it could be harnessed, it would be capable of doing very little useful work. Many other plans, all of them intensely interesting from a purely scientific point of view, were tried; but from most of them no current was obtained that was economically capable of being put to any industrial use.

Nature is a coy mistress, yet she likes to be wooed, and to the diligent suitor gives occasional tokens of encouragement; and it happened that one day I surprised her in her secret, and discovered the way by which we may abandon even combustion and heat itself, and convert the stored-up energy of coal *directly* into electricity.

It came to me almost as a revelation that if the oxygen of the air could be made to combine with the coal under such circumstances that the production of heat could be prevented, and at the same time a conducting path could be provided in which a current of electricity might develop, the chemical affinity of the coal for the oxygen would necessarily be converted into electricity and not into heat; for any given form of energy will be converted into such other form as the surrounding conditions make most easy. Given the proper conditions, the potential energy of coal would rather convert itself into electricity than into heat.

This led to experiments in which coal

was submerged in a liquid so that the oxygen of the air could not come in direct contact with the coal and produce combustion. Further, such a liquid was chosen that when air was forced through it to the coal, the oxygen of the air would temporarily enter into chemical union with the liquid and then be crowded out by a further supply of oxygen and forced to combine with the coal. We may picture each successive atom of oxygen, on its way from the source of air supply through the liquid to the coal, as temporarily entering into chemical union with each of a row of atoms of the liquid, just as each successive man as he circles around in the "grand right and left" of dancing temporarily clasps hands with each of the ladies of the set. When one substance passes through another in this way it furnishes a path in which an electric current may flow, so that by causing the oxygen to combine with the carbon through the intervening liquid opportunity is furnished for an electric current to develop, and since combustion cannot take place, the chemical affinity of the coal for the oxygen is converted directly into electricity, and not into heat. Liquids which thus allow atoms of oxygen and a current of electricity to pass through them may be called "electrolytic carriers."

I have thus discovered what I believe to be a new fact or principle not hitherto known to natural science—a principle which I hope may be as valuable to pure science as my invention promises to be valuable to the useful arts. Stated scientifically, my discovery is that if the oxygen of the air be caused to combine with carbon, not directly as in combustion, but through an intervening electrolytic carrier, the stored-up energy of the carbon may be converted directly into electrical energy, and not into heat.

Crudely speaking, my invention consists in generating electricity by causing the oxygen of air to combine with coal beneath the level of a suitable liquid.

The invention is a process; it is not a machine. The process may be carried on with very simple apparatus. An early form of apparatus consisted of a platinum crucible of the size and shape of an after-dinner coffee-cup, partially filled with common potash, that was kept liquid by suspending the crucible over a gas flame. Within the molten potash was suspended, by means of a platinum wire, a lump of ordinary coke of the size of a peanut. Into the molten potash a stream of air was blown by means of a platinum tube like a straw. The wire by which the carbon was suspended formed the negative pole, and a second wire attached to the crucible the positive pole, of the generator. Attaching these wires to a small electric motor, I found that when air was blown into the potash the motor started, and moved more rapidly as air was blown in; when the current of air was

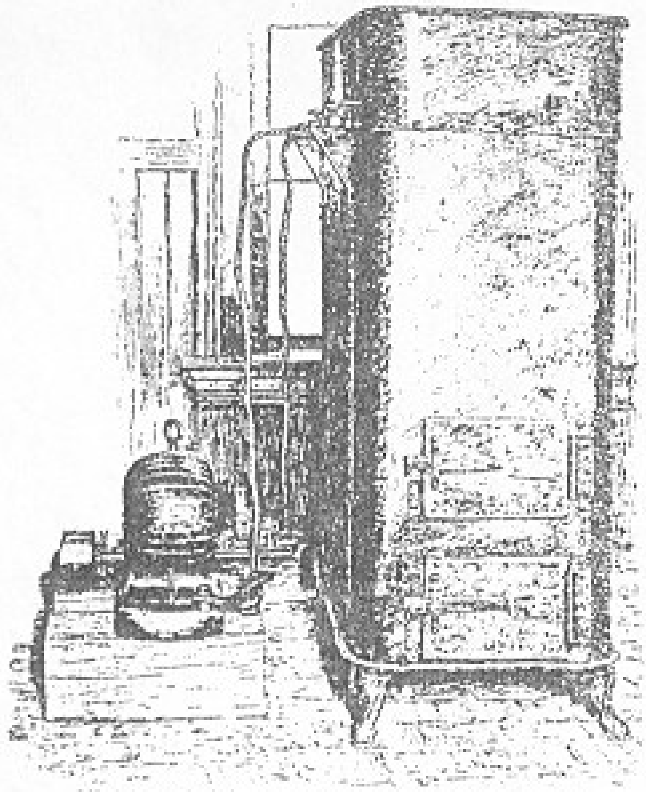


FIG. 2.—CARBON ELECTRIC GENERATOR.

Operating an electric motor. This generator consists of a heat-tight oven within which six cells like Fig. 1 are connected in series, and suspended over a coal-burning grate.

interrupted, the motor stopped. From this minute apparatus a current of several amperes was obtained. The electro-motive force was a little over one volt.

That the electric current was due to the chemical combination of the oxygen of the air with the coke (carbon), there could be no doubt. Quantitative tests showed that oxygen was taken from the air; that the carbon was consumed; that carbonic acid was formed. Moreover, the electromotive force obtained agreed almost exactly with that which is theoretically obtainable from the combination of oxygen with carbon to form carbonic acid (1.04 volts). That the phenomenon was not due to thermo-electric action was proved by the fact that when the whole apparatus was so enclosed that all parts were kept of uniform temperature the maximum electro-motive force and current were obtained. Again, later experiments with far larger apparatus have not only confirmed these results, but have shown that under proper conditions the electrical energy thus obtained is substantially equal to the potential energy of the weight of carbon consumed within the pot.

The invention had now been made. Electricity had been obtained directly from carbon. Would it work on a larger scale? Could the numerous practical difficulties be overcome? Platinum is more expensive even than gold, and hence some other metal must be used. Iron was tried, but the current obtained when the invention was practised in an iron vessel was very small.

Vessels of copper, lead, zinc, tin, aluminum, nickel, magnesium, were destroyed. Gold and silver gave good results, but inferior to platinum. Again and again the experiments were repeated. There seemed to be no reason in theory why iron should not work as well as platinum, and vessels were made from samples of iron of all kinds.

Finally the reason was found. Most specimens of iron have an oily surface, which, when heated, becomes converted into carbon, so that the action upon the carbonaceous surface of the iron tends to offset the action upon the proper carbon itself. This led to a method of cleansing the surface of the iron; and when properly cleansed an iron pot is as good as one of platinum, and of course far cheaper.

The pots were now made larger and larger, until to-day they are made as large as a barrel; and the current is measured in hundreds of amperes.

Numerous other difficulties have had to be overcome. Coal, as it comes to us from the mines, is not a good conductor of electricity, and though an experimental apparatus was constructed in which it was found possible to consume ordinary coke shovelled on to a submerged grate, it has been found best to crush the coal and mould it into large sticks of convenient size to handle, and bake them to drive off the included gases and give them good electrical conductivity.

The rapidity with which the carbon is consumed, and consequently the strength of the electric current yielded by a cell, is greatly increased by thoroughly impregnating all parts of the liquid with an excess of oxygen; and this is best done by terminating the air-supply pipe in a rose nozzle something like that of a watering-pot, so that the air is injected into the liquid in a large number of fine sprays.

There are many liquids that may be used as electrolytic carriers, but unfortunately the most suitable become liquid only at elevated temperatures; so a certain amount of coal or other fuel has to be burned on a grate beneath the pots to maintain this temperature. As, however, there is no considerable consumption of heat, excepting as it is used in warming the incoming air or is lost by radiation, we may expect that in large apparatus, where a number of large pots are enclosed in a reasonably heat-tight oven, the consumption of coal on the grate will become comparatively very small. Even with a small two-horse-power apparatus, in which no very great precautions were taken to retain the heat, measurements showed that only one-third of a pound of coal per electrical horse-power hour was burned on the grate. A steam-engine and dynamo of equivalent power would have consumed at least forty times as much.

Molten potash has many advantages as an electrolytic carrier, but it has the disadvantage of absorbing more or less of the carbonic acid given off by the carbon or contained in the air; so that if potash be used, although a part of the carbonic acid is swept away by the nitrogen, and

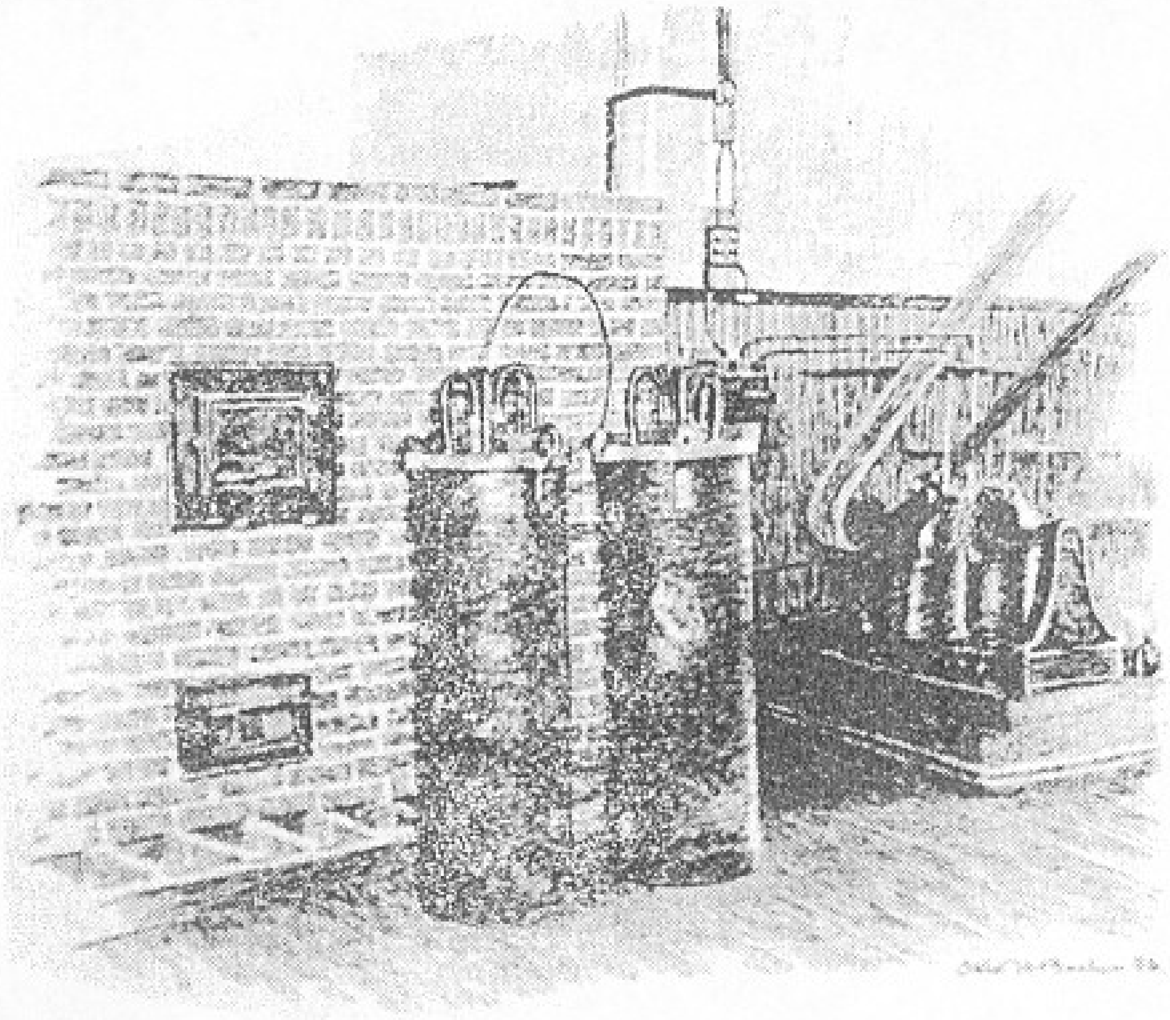


FIG. 3.—LARGE CARBON ELECTRIC GENERATOR,

With which experiments are now being made. The brick oven is ten feet square and six feet high. Two of the cells are shown removed. Each contains six carbons three feet long. It is expected that, when perfected, this generator will yield about forty electrical horse-power.

more may be carried to the surface and liberated by adding to the potash suitable carriers of carbonic acid, sooner or later the potash becomes contaminated and has to be cleansed. By choosing electrolytic carriers that have no affinity for carbonic acid the need of frequent cleansing is avoided, since, fortunately, the consumption of the carbon is so much more complete than it is in ordinary combustion that with reasonably pure grades of coal only a small amount of easily removable ash is formed.

The quantity of current that may be taken from a pot is about three-quarters of an ampere per square inch of carbon surface; so that a pot containing six sticks of carbon, each three inches in diameter and eighteen inches long—a size conveniently manufactured, handled, and used—yields about seven hundred and fifty amperes, or a little more than one electrical horse-power. The electro-motive force of each pot, whether large or small, is a little more than one volt. When greater voltage is desired, the requisite number of pots are connected in series and heated in one common oven. The air is pumped in by means of an electrically driven air-pump, operated by a small portion of the current generated.

It would be premature to attempt to give any final data as to the efficiency of the new process when practised on a large scale. Improvements are constantly being made. As compared with modern steam-engines, only relatively small carbon electric generators have as yet been built; and it should be remembered that with this generator, as with the steam-engine, increased size means increased efficiency per pound of coal, particularly in the coal consumed on the grate. Following, however, are some results of a test (made by experts not connected with the development of the invention) upon a small and comparatively crude two-horse-power carbon electric generator that has been in occasional use for some six months:

Average electrical horse-power developed	2.16 H. P.
Average electrical horse-power used by air-pump	0.11 "
Average net electrical horse-power developed	2.05 "
Carbon consumed in pots per electrical horse-power hour	0.223 lb.
Coal consumed on grate per electrical horse-power hour	0.336 "
Total fuel consumed per electrical horse-power hour	0.559 "
Electricity obtained from 1 lb. of coal (of which 0.4 lb. was consumed in the pots and 0.6 lb. was burned on the grate)	1336 watt hours,
or 32% of that *theoretically* obtainable.	

Thus the efficiency of this particular generator was twelve times greater than that of the average electric light and power plant in use in this country, and forty times greater than plants of corresponding size.

There are, however, many details still to be worked out, and many improvements yet to be made, before the carbon electric generator can be put into general commercial use on a scale comparable with that of modern steam-engines. Contrary to some statements that I have read, I believe it will be some time yet before the dynamo is relegated to the attic with the spinning-wheel, or the wheels of the steam-engine cease to revolve.

It is interesting to speculate as to what may be the outcome of this discovery when, in the fulness of time, all of these details shall have been worked out.

The first great field for this invention is power. The invention of the steam-engine soon doubled the productive capacity of the labor of the world. In this country alone it is to-day doing work equal to the hand labor of 100,000,000 men, or a population of 350,000,000 people. Now comes a power many times as efficient as steam, and much more convenient and useful.

There appears to be no insurmountable obstacle to the construction of carbon electric generators that shall heat and light our railway trains, and propel them with a velocity of one hundred miles an hour. Since electricity, unlike steam, may be applied directly as a rotary motion to every pair of wheels throughout the train, not only could the train be safely propelled with great velocity, but it could be started and stopped quickly, and would be under perfect control. There would be no cinders or smoke.

Our transatlantic liners — no longer "steamships" — would not then find a limit of speed set by fuel-carrying capacity. The greater part of the space now given up to coal, and all that is now devoted to boilers and engines, would be available for passengers and freight. Down near the keel are the generators, and along the shaft, gripping it and turning it at tremendous speed, are the motors, working directly and noiselessly, forcing a great ship like the *Campania* at a pace which breaks all records, and lands her passengers at Queenstown perhaps within three days of leaving Sandy Hook.

Our White Squadron, with its vital machinery safely placed well below the water-line; with its bunkers easily containing sticks of carbon sufficient to make it independent of frequent coaling stations; with its turrets revolved, its guns trained, its ammunition raised, and all its complicated mechanism moved by electrical hands; with absence of the telltale clouds of smoke, and with its superior power and speed—would be a formidable adversary to the other navies of the world.

Nor is the prospective change less start-

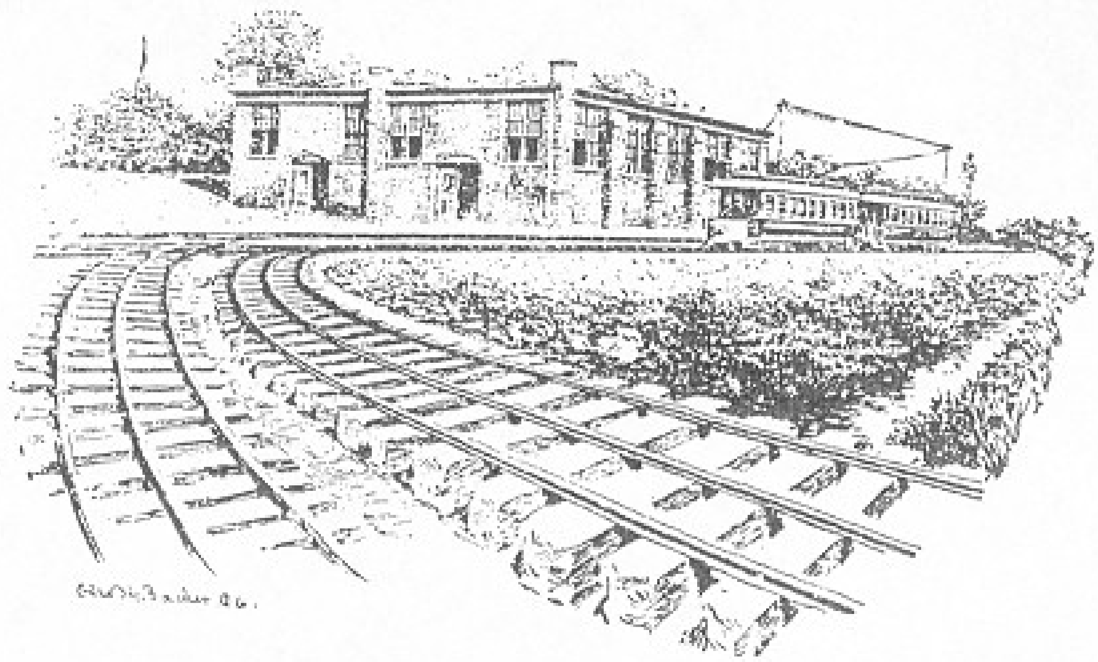


FIG. 4.—PROPOSED CARBON ELECTRIC POWER STATION FOR SUPPLYING CURRENT, BY MEANS OF A THIRD RAIL, TO HEAT, LIGHT, AND PROPEL RAILWAY TRAINS AND INDIVIDUAL CARS.

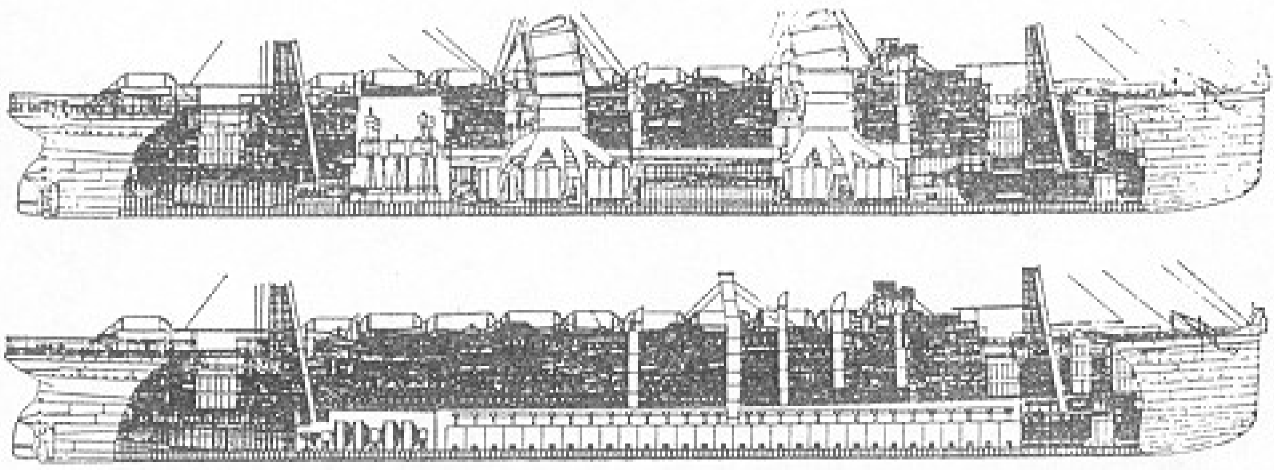


FIG. 5.—THE "CAMPANIA" AS SHE IS AND AS SHE WOULD BE IF EQUIPPED WITH CARBON ELECTRIC GENERATORS; SHOWING SPACE OCCUPIED BY MACHINERY IN EACH CASE.

ling in matters of household economy. Cheap current means not only cheap electric lighting, but heating and cooking by electricity. Apart from the question of expense, the electric warming of dwellings is ideal; for it means even temperature, automatically maintained in each room at any desired degree, perfect ventilation, and doing away with the wasteful use of coal, with the labor and the dirt and the dust which accompany it.

We are just beginning to appreciate the value of the electric current in metallurgy as a means of reducing metals from their ores. Cheap electricity means the cheap production of copper; it means bringing aluminum into general use in the arts; it means great increase in the production of gold and silver; it means changes in the great iron industry and the production of steel.

The possibilities of the future application of electricity to other branches of chemistry we can now but dimly see, but it is certain that the use of this form of energy, whose chemical power is such that it can dissociate comparatively valueless forms of matter into their constituent elements and recombine these elements into new compounds of great value, has far-reaching possibilities upon the future civilization of man.

Then there is the advantage of comparatively pure air in our larger cities that would result from the absence of the smoke and soot of the millions of tons of coal now burned. The difference between city air and the pure air of the country is largely, if not chiefly, due to the contamination by carbonic-acid gas and smoke. Think of a smokeless London!

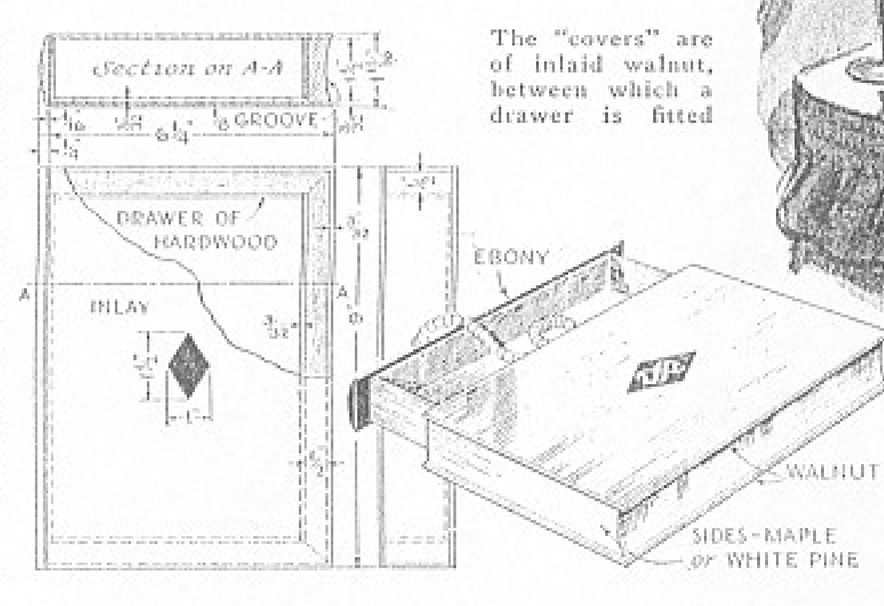
Popular Science Nov. 1935

GIFT JEWEL BOX OF WOOD LOOKS LIKE BEAUTIFULLY BOUND BOOK

DESIGNED to resemble a book, the jewel box illustrated is an unusually attractive project for a Christmas gift. It requires very little stock and there is nothing difficult about the construction.

The box or cover is made of three sidepieces of maple or white pine with mitered joints, and a top and bottom of 3/32-in. walnut. The long sidepiece is grooved about 1/8 in. deep as indicated. This can be done by hand with a gouge, or the groove may be cored out with a circular saw. The top and bottom pieces may be inlaid with a small lozenge of holly or other light wood as shown, or with a more elaborate inlay, if preferred. The other part is merely a drawer of hardwood made in the form of a box to slide into the cover. To the front of the drawer is glued a piece of ebony or other dark wood shaped like the slightly rounded back of a book.

Apply a light wood filler to the walnut; then give the entire box a rubbed varnish finish.—FRANK SCHNEIDER.



The "covers" are of inlaid walnut, between which a drawer is fitted

Energy From the Lens

Parabolic, or dish type, solar reflectors are all the rage today. The drawback is that they are bulky and immobile.

The lens, however, is much more compact and therefore easily moved about. Also, since it directs its heat downward instead of upward, as in the case of the solar reflector, its applications are more numerous than those of the parabolic reflector.

Two lenses, mounted one above the other (see page 944, figure 8) could be used to run steam vehicles from runabouts to tractors.

Of course, the runabout and other machinery could only be used on sunny days. The lens powered steam tractor or other farm machinery would be a boon to agriculture as most of the work is done in the sunny month. Even so, auxiliary power sources could be used to run them on cloudy days.

A runabout should, of necessity, have an alternative power source but the savings in fuel would soon pay for any modifications.

You have only to imagine the water reservoir jutting from beneath the steam engine like a long foot so the lens could constantly focus on it. Also, the lens, or lenses, would not have to be so powerful since the idea is not to melt the object focussed on but to heat the water inside.

In the case of a runabout or other machinery, a manual focusing bar could enable the operator to keep a general focus with little loss of time or attention from the operation of the machine. Most focusing adjustment would apply to turns for mobile machinery and every fifteen minutes or so with stationary machinery. The foot could be broad enough so that it would take several minutes for the point of heat to traverse the area.

Lest the idea of building heavy glass lenses of great optical precision make you feel frustrated, just consider plastic lenses filled with water or clear oils. Such plastic lenses are easy to make and can be formed in a kitchen oven.

When you work out the specifications of your lens you can make a lens mold from clay mixed with water. Form it on a board and dry it in the kitchen oven. Make it a size a little larger to allow for shrinkage. If it cracks, so what? You can just push it together and go on with the job.

Get some thick sheet plastic, maybe one quarter inch, and lay one sheet on the mold in the oven. You can adjust it as the heat softens it. When you have a square of sheet plastic with a lens shape in its middle, make another.

Then use plastic glue or epoxy to stick the two pieces together on the flat surfaces. Don't trim the flat surfaces off. Leave well enough alone. Drill a hole down through the outside edge into the lens and fill all the way with water or some clear oil. Use a wooden plug or one with a point so there will be no air bubble to contend with in the lens.

Now just mount the square sheet of plastic with the lens in its middle in a wooden or metal frame and you'll have something as good for its purpose as any lens grinder could make from glass.

I've never done the above but the principles are obvious. When I get around to actually doing it I'll improve on it. But don't wait for me. Fortune is right around the corner. Get at it.

For more information, read "Burning Glass", on page 404, "Lenses", on page 1337 and "Solar Power of the Past", on page 944. Of course, read the article below, published in Harpers New Monthly Magazine in Oct. 1877. This has the most science concerning burning glasses I've yet come across.

POPULAR EXPOSITION OF SOME SCIENTIFIC EXPERIMENTS.

BURNING GLASSES AND MIRRORS. THEIR HEATING AND CHEMICAL EFFECTS.

UNQUESTIONABLY the most important discovery ever made by man was that of kindling and keeping up a fire. It permitted the geographical distribution of our species over a wider space; it rendered intellectual development possible.

There are philosophers who would have us believe that we have been evolved out of some low animal form; there are, also, theologians who tell us that the world was made out of nothing, and we out of the dust of it. They relate the incident with much circumstantiality. We might suppose that one of their ancestors had been an eye-witness; but that supposition would itself require an explanation.

Between these philosophers and these theologians a conflict of no common bitterness rages. They are vexing the world with their clamors. Perhaps, then, we, who merely want to get at the truth, may, in the interests of public peace, invite them to consider the things about which they are quarreling from a different point of view.

What would be the result if the art of kindling and keeping up a fire were suddenly lost?

If we can have an answer to this question, we may perceive with some distinctness what it was that took place in consequence of the original discovery of that art.

The geographical distribution of plants and animals depends altogether on the distribution of heat. A certain low degree of temperature limits the life of every species, and therefore fixes boundaries to the region in which it can exist. The organization of man is so delicate that throughout a large portion of what we call the temperate zone he could not withstand the rigor of winter. His individual powers of locomotion are so restricted that he could not become to any great degree an animal of passage. He has neither the flight of the bird nor the endurance of the buffalo. He could not, like them, pursue the northward journey of spring when the sun crossed the line, nor the southward journey of autumn when the sun recrossed it. The structure of his teeth and his digestive organs is such that he must carry his food with him. A pigeon can fill its crop with rice in Carolina, and breakfast the next morning in Canada. The buffalo can find ample supplies as he goes on the luxuriant prairies of the West.

A loss of the art in question means, then, practically an abandonment of a large portion of America, Europe, and Asia. The winter's cold of such regions would render them as uninhabitable as are the icy pinnacles of that glittering fiction of modern nautical fancy, the Paleocrystic Sea.

Then the human race could not have

spread from its original tropical home had it not possessed the control of fire, which gave it the power of creating artificial climates, and raising the mean temperature of winter.

Whoever is disposed to carry out these amusing yet not altogether worthless speculations will doubtless perceive that the change of environment to which man was exposed in this his dispersion over the face of the earth left an impression on his aspect, and even on his anatomical structure. To this such a philosophizing inquirer may add an investigation of what must have taken place in consequence of the use of cooked food. The orang, or chimpanzee, or gorilla, stands by while man lights and uses a fire, but never does it occur to him to imitate what is thus taking place before his eyes. That is a grand point of distinction between him and us. If he could descend from his native trees and roast his nuts, instead of eating them raw, he would have taken the first step in that journey which might eventually bring him to the table of Lucullus, and transform the wives and daughters of his descendants into the butterfly ladies of Paris.

Our philosophizing inquirer must, however, bear in mind that climates were not always the same as they are now. There was a day when the reindeer was grazing in the Pyrenean valleys, along the edge of the great ice sheet that covered all Middle Europe. There was a day, before that, when the camelopard was wandering all over that region, and the hippopotamus bathing himself in its waters. Again and again there have been grand vicissitudes of temperature, hot periods of prodigious duration alternating with similar cold ones. A study of the effects of these will furnish abundant occupation for the knowledge and ingenuity of the philosopher who addresses himself to the consideration of the problem, and afford to his antagonist, the theologian, rare opportunities for examining and upsetting his conclusions.

I suppose that the first artificial lighting of a fire consisted in the judicious rubbing together of two sticks. Some tribes of savages still continue to follow that plan. Were we disposed to pleasantry, we might picture to ourselves the astounded countenance of that old anthropoid whose eyes first stared on the amazing event, whose fingers first discovered that fire will burn. No wonder that a spirit of further inquiry was lighted up in his bosom, and that unwittingly he entered on that career which we call civilization. No wonder he thought that the shining and pain-inflicting being that he had thus evoked was something worthy of worship.

But to rub two sticks together is of the earth, earthy. After very many ages it was found that fire might be brought down from heaven, the genial warmth of the sun concentrated into scorching heat by a concave polished metal or mirror. The preservation of a public or national fire became a state institution both in Europe and America. In both there were Vestal virgins, bound under the direst penalties to wait unremittingly on the sacred altar. If its fire were extinguished, the extinction of the state itself was foreboded. In Italy, with great ceremony, the altar was rekindled by the ancient plan of rubbing together two sticks from a sacred tree. In Cuzco the Peruvians permitted the fire to die out on midsummer-day, and then, with imposing solemnities, rekindled it by collecting the sun's rays with a concave mirror.

A concave mirror is not, however, the only means of obtaining fire from heaven; a convex lens is equally effectual. Such a one, made of transparent quartz, and found in the ruins at Nimroud, shows that in Asia this was long ago understood.

The designation of burning-glasses has been used indifferently for mirrors and lenses. Their power increases with their size. It is as the square of the diameter of the lens or mirror is to the square of the diameter of the focal image it yields.

Consequently the heating power of these instruments may, without difficulty, give rise to very surprising results. Villette, a French optician, made a mirror of speculum metal nearly four feet in diameter; its focal image was about half an inch. So tremendous was the heat in that focus that asbestus was at once melted into glass, a diamond was rapidly consumed, a piece of cast iron melted in sixteen seconds, some slate in three seconds.

Such was the effect of a *mirror*. Tschirnhaus constructed a *lens* of about three Rhenish feet in diameter, condensing the rays coming from it by another, so as to diminish the area of the focus. Of this glass it is said that it vitrified tile, slate, pumice-stone, in a moment. It melted sulphur, pitch, and rosin under water; it converted wood ashes into glass; "any thing put into its focus was either melted, burned up, or turned into smoke."

Tschirnhaus believed that by the excessive heat of great lenses a revolution in chemistry would be effected. But in all Saxony, where he resided, there was no glass-house that could undertake the manufacture of one so large as he required. The King of Poland gave him permission to establish one in his dominions, and in other respects promoted his operations. The great lens he produced was the wonder of those times. It was perfectly polished up to its very edge. Its focal image was "exactly round," "a proof of its excellent figure." Some of its effects were regarded as "almost miraculous," and were received with incredulity; but the lens having been bought by the Duke of Orleans, was carried to France, and proved an irreproachable witness in his favor. A similar one he presented to the Emperor Leopold, and, still later, made one four feet in diameter, which, however, was accidentally injured. In these particulars I am quoting from the *éloge* pronounced upon his memory in 1709 before the French Royal Academy of Sciences.

Sir Isaac Newton presented a burning-glass to the Royal Society. "It consisted of seven, so placed that all their foci joined in one physical point. Each was about eleven inches and a half in diameter; six of them were placed around the seventh, so as to form a kind of segment of a sphere, the subtense of which was about thirty-four inches and a half, and the central glass lay about an inch further in than the rest. The common focus of all was about twenty-two and a half inches distant, and about an inch in diameter. It could vitrify brick or tile in a single second, and melted a gold coin in a few moments."

Macquer, the French chemist, found that glass quicksilvered like an ordinary looking-glass answered very well. With a concave only twenty-two inches in diameter and twenty-eight in focal distance, he melted platinum; and flint, that had been powdered to prevent its crackling and flying about, secured in a large piece of charcoal, bubbled up and ran into a transparent glass in less than half a minute. Hessian crucibles and glass-house pots vitrified completely in three or four seconds. Forged iron actually boiled as soon as it was put in the focus.

Trudaine constructed a lens of two hollow segments of glass, four feet in diameter, containing alcohol between them. It cost $5000. He was, however, disappointed in its action. It could not melt platinum. He presented it to the Royal Academy of Sciences, but shortly afterward it was accidentally broken.

Perhaps the most celebrated burning-lens was that made by Penn, of Islington, for Mr. Parker. It was three feet in diameter, and exposed in its frame two feet eight and a half inches in the clear. In its centre it was three and a quarter inches thick. By a second lens, which received the rays of the former, the focus was brought to a diameter of half an inch. Almost every substance that was tried melted in an instant in its focus—platinum, nickel, lava, asbestus, slate. This lens cost $3500. An attempt was made to raise a subscription for purchasing it from its owner, but that failing, it was bought by an officer who was attached to Lord Macartney's embassy to China, and who left it at Pekin.

The great naturalist Buffon demonstrated that the story of the burning of the Roman fleet at the siege of Syracuse by Archimedes, and that of the navy of Vitellius by Proclus, might be something more than a mere legend. He constructed a machine of plane mirrors that could set wood on fire at a distance of more than 200 feet. To him and to Condorcet we owe the first suggestion of the polyzonal lens—a great improvement in the burning-glass and in light-house lenses.

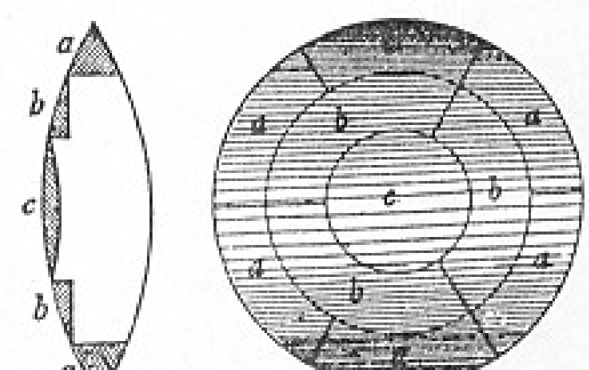


FIG. 1.

In Fig. 1 is represented a polyzonal lens as devised by Brewster. It is in three pieces—two rings, *a*, *b*, and a lens, *c*. When the size is very great the rings may be composed of several pieces, as shown in the front view, in which the lens is composed of ten

pieces. Among many other advantages presented by the polyzonal lens is the conspicuous one that the loss of light by absorption of the glass is greatly reduced, the lens being so much thinner than a solid one of corresponding size.

The chemists of the last century used the burning-glass under both its forms, the mirror and lens, very frequently, since it was, until the invention of the voltaic pile and the oxyhydrogen blow-pipe, the best means for obtaining high temperatures, and particularly for igniting substances in the interior of glass vessels. Thus Priestley employed it in causing the union of iron with oxygen, and the reduction of the resulting oxide by ignition in hydrogen, showing that the same portion of metal could be acted upon in this manner repeatedly. He explained the results he thus obtained on the principles of the phlogistic theory. It was thus, too, that the diamond was first oxidized, and Newton's singular prediction as to its combustible nature verified.

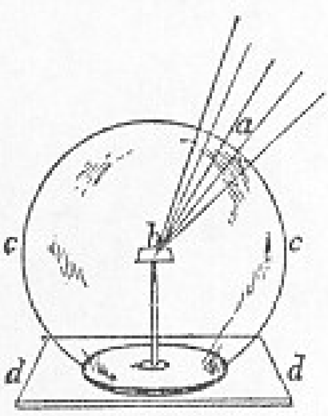


FIG. 2.

In Fig. 2, *a*, the sun rays converging to a focus at *b*. They are received upon a stand supporting the substance to be tried; *c c*, a glass receiver resting upon an air-pump plate, *d d*.

When, more than forty years ago, I commenced an experimental examination of the chemical action of light, I entertained great expectations of what might be accomplished by the use of burning-glasses. It seemed

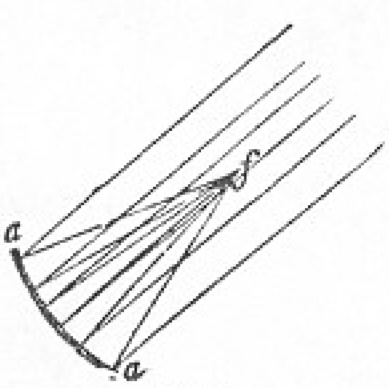


FIG. 3.

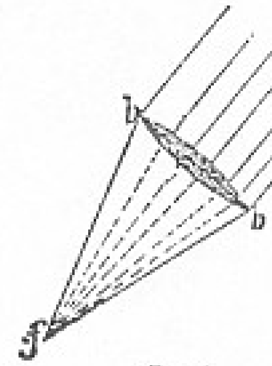


FIG. 4.

reasonable to suppose that if the direct sun rays could occasion so many decompositions, their chemical force would be incomparably greater when their brilliancy was exalted by a mirror or a lens. Of the two, a concave metallic mirror should produce a more characteristic effect, since it returns the rays as it receives them, but a special and very important portion of them is absorbed by the selective action of the lens.

In Fig. 3, *a a*, a concave mirror reflecting the sun rays upward. In Fig. 4, *b b*, a convex lens converging the sun rays downward to a focus at *f*. The latter is the more convenient form for experimental use.

I had not, however, at that time the means of making these experiments in a satisfactory manner, and though very much disappointed with the result, postponed the prosecution of them to a more favorable opportunity. Obtaining from time to time several isolated facts, I was led, in meditating upon them, to what seemed to be some general conclusions respecting the chemical action of radiations. Several of these were published, in a desultory manner, in the periodicals of the time, and it was not until May, 1851, that they were collected in the *Philosophical Magazine*, under the title of a "Memoir on the Chemical Action of Light." Of this, the following is an abstract.

The general discussion of the problem of the chemical action of a ray involves the following considerations:

1. In what manner does the ray act, and what are the changes it undergoes?

2. What is the nature of the impression made on the material group, the decomposition of which ensues?

Many facts justify the supposition that the parts of all material substances are in a state of incessant vibration. To each particular thermometric degree there belongs a particular frequency of vibration. As soon as these motions approach four hundred billions in a second, red light is emitted, and the temperature is near 1000° F. As the frequency increases, rays of a higher refrangibility are in succession evolved, and the temperature correspondingly rises. On the other hand, when these oscillatory movements decline, the temperature of the body falls.

These principles lead to a ready explanation of the nature of the exchanges of heat and the cause of the equilibrium of temperature. The vibratory molecular motions are necessarily propagated to the ether, through which medium they are again transferred to the particles of other bodies, on which the ethereal waves impinge, as a vibrating string excites undulations in the air, and these, in their turn, can give birth to analogous motions in other strings at a distance.

There is an analogy between the relations of a hot and cold body and those of two strings, one of which is emitting a musical sound and compelling the other to execute synchronous movements. The ether in the one case and the air in the other are the media through which their motions pass.

Equilibrium of temperature takes place when the molecules of the substances concerned are in synchronous and equal vibration. A hot body in presence of a cold one compels the latter to hasten its rate of motion, its own rate all the time declining, and this continues until both have the same frequency; then equilibrium of temperature results. The theory of the exchanges of heat is, therefore, only an expression for the exchanges of vibrations through the ether.

But temperature in thermotics is the equivalent term for *brilliancy* in optics. Both refer to compound qualities, depending not only on *frequency* of vibration, but also on its *amplitude*. As the degree of heat of a mass rises, the mass expands, the increase in its volume indicating that not only do its parts vibrate more swiftly, but also that their individual excursions are increased. It follows, therefore, that every mass will have a determinate volume for every degree of heat, a volume increasing as the temperature rises. On this view the explanation of the expansion of bodies by heat is that their parts are not only vibrating more quickly, but also that the individual excursions are greater.

The atoms of the chemical elements differ in weight. We therefore should not expect that the ethereal vibrations would throw them into movement with equal facility, but some would yield more readily than others. Is not this what we express in chemistry by the term specific heat?—a body, the capacity of which is great, requiring a prolonged application of ethereal pulses before a consentaneous motion is reached, and in its turn impressing on the ether during cooling a correspondingly prolonged series of motions. And is not this the cause of that remarkable relation between the atomic weights of elementary bodies and their specific heats, discovered by Dulong and Petit?

These considerations may lead us to inquire whether the general cause of the decomposition of compound bodies by radiations is due to the circumstance that all the atoms of which their molecules are composed take on the vibratory motion with unequal facility. Thus if a certain compound molecule be submitted to the influence of an intense radiation, some of its constituent particles may vibrate consentaneously at once, and others more tardily. Under these circumstances the continued existence of the group may become impossible, and decomposition ensue in the necessity of the case.

In entering upon the experimental analysis of the action of a ray upon a decomposable body there are three different points to be considered, so far as the ray itself is concerned: 1. To what extent and in what manner is the result affected by the *intensity* of the ray, or by the *amplitude* of the vibrating excursions? 2. How is it affected by the *frequency* of the pulsatory impressions? and 3. How by the *direction* in which the vibrations are made, as involved in the idea of polarization? I shall now examine these in succession.

1. *To what extent and in what manner is the decomposition of a compound body affected by the* INTENSITY *of a ray, or by the* AMPLITUDE *of the vibrating excursions?*

If the different degrees of facility with which atoms receive the impression of ethereal vibrations be the true cause of decomposition by light, we should expect that many such changes would become possible under the influence of a burning-lens which are not so in the direct rays of the sun.

This idea is favored by what we find in the case of heat. The burning-glass has long had celebrity in that respect, and in former times was the most powerful means of reaching a high temperature.

The effect of the glass is due to the rapidity with which it can supply caloric, contrasted with the loss by conduction, radiation, etc. Thus an object of any kind exposed to the sun receives heat at a certain

rate; but it is simultaneously experiencing a loss by conduction, radiation, and currents in the air. Exposed to the focus of a lens, the supply becomes, in a given time, greater than before, and the temperature rising, great effects are the necessary result.

But changes brought about by light are in a different predicament. Here conduction is entirely absent, as is also loss by currents in the air. The cumulative effects of a long exposure give the same action as a highly concentrated ray furnishes in a brief period of time. In this case, therefore, every thing will depend on the absorptive power of the substance.

When a piece of polished silver is placed in the focus of a burning-lens, it remains quite cold, because of its high reflecting power; but if blackened, it melts in an instant. And so with chemical changes. A body which, like chlorine, can exert an absorptive action on the ray, becomes modified, and induces changes; but if, like oxygen, it has not that property, it will remain indifferent and unaffected by the most intense radiation.

Considering, however, that the calorific effects of the converged solar rays are so striking, we may reasonably inquire whether, in like manner, the chemical action can be increased. There is a very general impression that the intense radiation of tropical climates accomplishes changes which can not be imitated by the feebler light of higher latitudes, and perhaps decompositions may be brought about by a large convex lens which the direct rays of the sun are wholly inadequate to produce.

A very brilliant beam may possibly break up a given combination, which a far greater quantity of light, acting through a long period, might be inadequate to touch. Sir R. Kane states that he, with M. Dumas, could remove two atoms of hydrogen from acetone by the action of chlorine in the sunshine at Paris, but in Dublin only one.

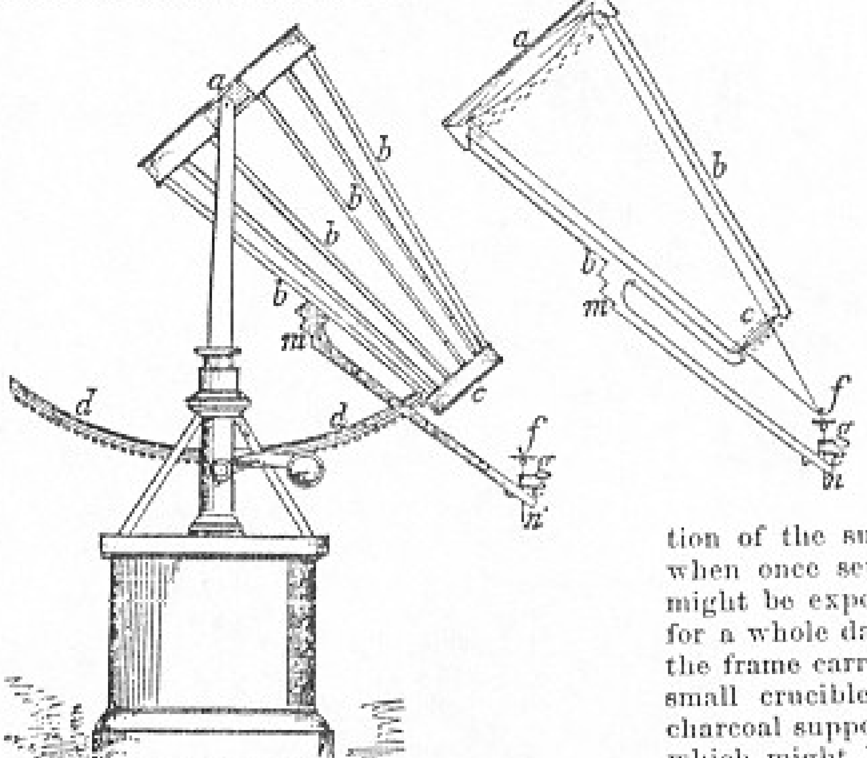


FIG. 5.

In Fig. 5, *a*, the convex burning-lens supported in ribbed frame, *b b*; there is at *c* a second lens to hasten the convergence; *d d*, a circular arc for directing the lens toward the sun; *e g*, a stand on which objects may be exposed to the focal point, *f*. It is carried by a stout bar, *m n*, attached to the frame.

I have endeavored to collect a series of facts which might set this part of the question in its true light. My first experiments were made with a lens of very fine and thin French plate-glass, twelve inches in diameter in the clear. Its goodness was such that on a fine day platinum might be melted in its focus. It was ground and polished for me by the late Mr. Fitz, whose skill was shown in the large and excellent telescopic objectives that he made. He mounted the lens on a suitable support; it required, however, to be guided by the hand as the sun moved. When the college building of the Medical Department of the University of New York was destroyed by fire in 1865, I had to regret the loss of this instrument, with much other apparatus, and many documents that were of unappreciable value to me. Mounted as the lens was, its use was attended with considerable risk to the eyes, on account of the excessive brilliancy of the focus. Screens and dark spectacles were found to be very unsatisfactory, and an illness which I consequently contracted admonished me either to abandon the subject or pursue it in some other way.

In Fig. 6, *a a*, the heliostat clock; *b*, its polar axis; *d d*, a frame carrying the lens, *c*, and having an arrangement at *f* for supporting flasks, crucibles, or other apparatus. This turns on a double joint at *c*, so that the lens may be directed to the sun.

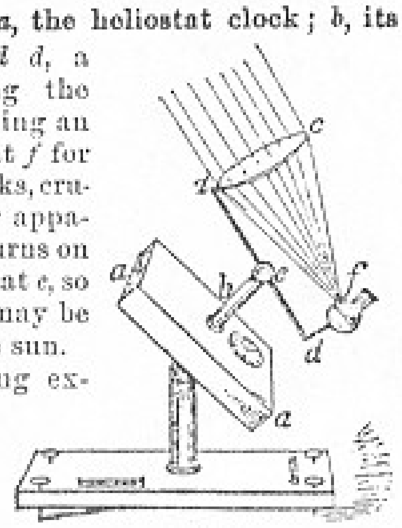


FIG. 6.

The following experiments were made with a smaller glass, consisting of a combination of two similar lenses, their diameter being five inches and focal distance eight. It was, in fact, the large lens of an old-fashioned lucernal microscope, such as was made in London a century ago. I had it fixed on a polar axis, as shown in Fig. 6, and by the aid of a clock *it could follow the motion* of the sun with such accuracy that, when once set in the morning, an object might be exposed in its focus, if desirable, for a whole day. It had a contrivance on the frame carrying the lens for supporting small crucibles, glass matrasses (Fig. 7), charcoal supports, etc., at the proper point, which might be either at the focus or at any other distance from the lens, as the circumstances of the experiment required. Among these instruments were thermometers, blackened or otherwise so arranged as to exercise any desired selective absorption. At the outset of any experiment, the whole face of the lens could be covered with a blackened pasteboard screen, with a hole half an inch in diameter. Through this a sufficient amount of light could be transmitted to enable one to arrange the various details of the proposed experiment, and when every thing was ready, the screen was removed, and in the concentrated and brilliant focus the action went on. I found that this simple contrivance was an invaluable relief to the eyes.

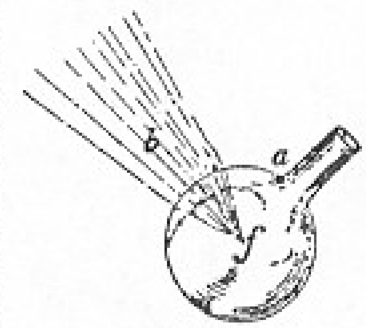


FIG. 7.

In Fig. 7, *a*, a small flask receiving the converging rays, *b*, at their focus, *f*.

The lens being five inches in diameter, and the space covered by the solar focal image, owing to want of achromaticity and spherical aberration, one-fifth of an inch, the multiplying effect would be 625 times, if the glass were perfectly transparent, and there were no loss by reflection from its surfaces. On a summer day of average brightness, with the thermometer at 68° in the shade, and the bulb, not being blackened, at 108° in the sun, this lens could fuse copper instantly, the bead oxidizing only superficially, and cutting readily after fusion. Black oxide of copper in a little crucible of platinum foil melted into a slaty-looking substance at once. Wrought iron did not melt alone, but if exposed on a charcoal support in a globule of microcosmic salt, previously fused by the lens, it gave a clear, round bead, which readily extended when beaten upon an anvil. The globule of flux turned black. The specimen employed was cut from a piece of good iron wire, and though it might be thought that exposure on the charcoal would tend to turn it into cast iron, its subsequent complete malleability seems to disprove this. Spongy platinum did not melt alone, nor even if inclosed in a globule of fused microcosmic salt. We may therefore estimate the working power of this lens on a substance placed in its focus as somewhat above the point of fusion of wrought iron, and lower than the point of fusion of platinum. This refers to temperature only. The power of the lens as to light must be enormously greater.

We may now examine the chemical effects produced by this lens.

Two small glass matrasses, the bulbs of which were about half an inch in diameter, were filled with chlorine water, the one being exposed to the direct rays of the sun, the other to the converging rays of the lens. Decomposition of the water occurred in both, but with far more activity in that placed in the focal point. The difference was at once so striking to the eye that I made no attempt to measure it. It is plain that the greater the quantity of incident light, the more rapid the decomposition; though, after the first moment of action, the solutions being no longer the same in constitution, the quantities of gas disengaged are no longer proportional to the incident light.

There is thus no difficulty in effecting the decomposition of water by chlorine under the influence of the sun, but under the same circumstances iodine and bromine are inadequate to produce such an effect.

A solution of bromine in water was prepared, the water being first boiled to expel the air contained in it. It was placed in a half-inch matrass, and exposed to the focus of the lens (Fig. 8). As the temperature rose rapidly, the water was depressed in the bulb by the steam and bromine vapor which occupied the upper part, the bulb being placed uppermost, and the tube dipping into a small vial which served as a reservoir. After the exposure had continued for two hours and a half, the matrass was removed from the lens, and suffered to cool. There remained uncondensed a little bubble, measuring about $\frac{1}{100}$ cubic inch; but this was probably nothing more than the atmospheric air which had found access to the water, for on submitting the same specimen to another exposure for three hours, after the gas had been decanted from it, a little bubble, the diameter of which was estimated at one-fiftieth of an inch, was all that could be procured.

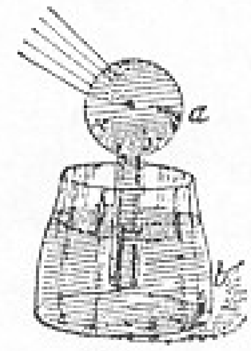


FIG. 8.

In Fig. 8, *a*, the flask containing the bromine water; *b*, a bottle serving as a reservoir. It is half filled with the same water.

In like manner I endeavored to decompose water by iodine, and with the same negative result, even when the exposure to the focal point lasted for four hours. When proper care had been taken to remove from the solution all traces of air, no gas was evolved.

To reduce the heating effect of the lens, and allow the more refrangible rays alone to act, there was interposed between the lens and its focus a stratum of a solution of sulphate of copper and ammonia one-third of an inch thick, and included between two flat plates of glass, suitably arranged and carried along with the other parts by the movement of the clock. The cone of solar rays now passed through this absorbent medium (Fig. 9).

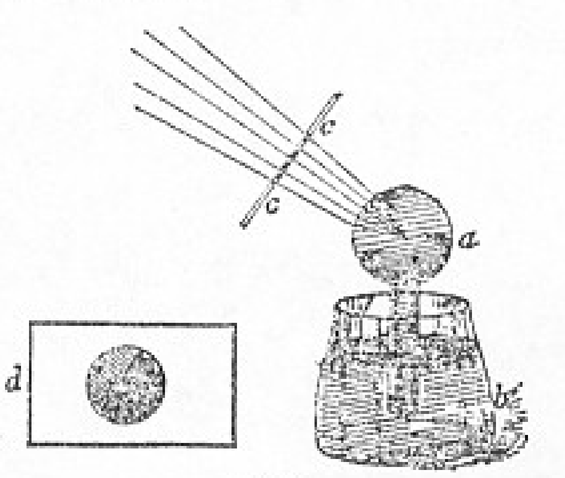


FIG. 9.

In Fig. 9, *a b* is as in Fig. 8, but the converging rays pass through an absorbent trough, *c c*, shown in front view at *d e*, *e* being the circular cell containing the blue solution.

In the focus of blue light thus formed there was exposed for two and a half hours (from $7\frac{3}{4}$ to $10\frac{1}{4}$ A.M., June 13, 1848) an inverted half-inch bulb, containing iodine water, with a few particles of iodine. Temperature in the shade, 64°; in the sun, 86°. At the end of that time there was found an insignificant bubble of air, estimated at one-thirtieth of an inch in diameter. It could, of course, be nothing but atmospheric air.

The absorbing medium was now removed, and the full rays of the sun permitted to converge on the matrass. The temperature of the water quickly ran up to the boiling-point, and the bulb was filled with steam and the purple vapor of iodine. Every thing seemed favorable for the decomposition of the water to take place, if the iodine could accomplish it under so intense a radiation. At first I thought that the experiment had succeeded, for the color of the bulb became paler—a result that ought to have ensued if hydriodic acid was forming and oxygen being eliminated. The action, therefore, was kept up for four hours; but as soon as the sun was screened from the lens and the bulb began to cool, the water returned and filled it almost entirely. This, therefore, shows that under a most intense radiation iodine can not decompose water.

A similar experiment was tried with bromine, and with the same result. It failed to decompose water.

Some silver chloride, carefully purified, was exposed in a little crucible of platinum foil (Fig. 10) so inclined that the cone of rays could come in at its mouth. The absorbing trough was not used. Though the sun's rays were not brilliant, the chloride at once melted, forming a reddish-looking liquid. It was kept in that condition all day. When cool, it proved to be in the state of horn-silver, easily cut by a knife. When the rays first touched it, a fume was disengaged, due probably to the escape of vapor of water. It seems, therefore, that this substance when perfectly dry is not decomposable by sunlight, though so sensitive at common temperatures when moist.

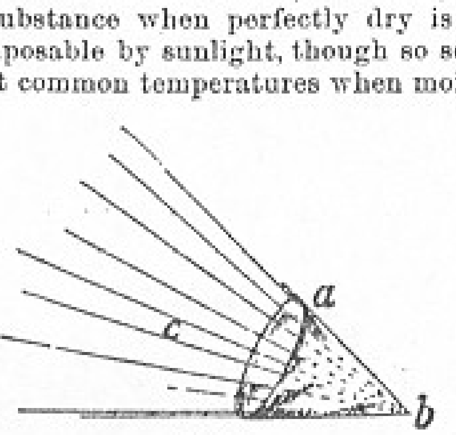


FIG. 10.

In Fig. 10, *a*, the platinum crucible; *b*, the place of the material experimented upon, receiving at their focus the converging rays, *c*.

I must refer to the original memoir for the detail of numerous experiments on many metallic compounds, the general result of these being that, no matter how brilliant a ray may be, it can not carry a decomposition further than a feeble one acting for a corresponding longer period of time could do. Compounds that can resist the force of an ordinary ray can not be broken down by the intense illumination of the focal point of a burning-lens. That instrument can not do what the voltaic pile has done—effect decompositions which had never been effected before.

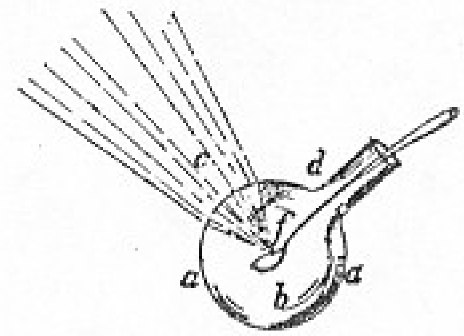


FIG. 11.

In Fig. 11, *a a*, a matrass filled with water, through which come in the converging rays, *c*. Through the neck at *d* a spoon, *b*, may be passed down to the focal point, *f*.

To reduce the disturbing effect of heat as far as possible, and give every advantage to the condensed luminous focus, I received the cone of rays coming from a twelve-inch burning-lens on a glass globe (Fig. 11) six inches in diameter, filled with water. This increased the converging of the rays, and brought them more quickly to a focus. Then through the neck of the globe was introduced to the focus, in a matrass, spoon, or other suitable support, the substance to be experimented upon. The mass of water kept the temperature down, and in some cases the hot water was removed by an aspirator and cold water introduced below. A spoon could be used when powders were employed of so great a specific gravity as not to drift too high from the focus in the ascending current of hot water.

The result was, however, the same as before. The focus of a burning-lens can not cause any chemical change which the unconverged sun rays are incompetent to produce. It merely hastens the effect.

Upon the whole, we may therefore conclude that it is not the *intensity* of a beam which determines its decomposing power, and that we can not produce greater chemical effects by the action of converging mirrors and lenses than we can by the application of the simple sunbeam, continued for an equivalent period of time.

In estimating the influence of light on different solutions, we should constantly bear in mind that the maximum effect is never produced unless complete absorption has taken place. When the color of a solution is pale, it may require considerable thickness before complete absorption is accomplished. Thus if two equal tubes, containing equal quantities of the same solution of chlorine in water, be exposed to the rays, they will evolve equal quantities of oxygen gas; but if behind one of them a piece of looking-glass be placed, the effect on it is immediately increased. The rays that have passed through the solution and produced their effect are compelled to cross it again, and, if not already exhausted, thus to act once more. The following illustrations are examples of the same kind:

Two small bulbs of equal size containing chlorine water were exposed to the rays of the sun; behind one of them a concave hem-

ispherical mirror was placed so that the rays which had crossed the solution were compelled to cross it again. The amount of oxygen set free in this bulb was about one-fourth greater than that in the other.

The same was repeated, the exposure being to the sky light instead of the sun rays. The quantity of oxygen set free in the two bulbs was as 18 to 55.

It might be supposed that part of this increased effect is due to the rise of temperature, from the mirror obstructing radiation. To exert a cooling action the following modification was therefore tried. In a glass jar (Fig. 12) full of quicksilver a half-inch bulb containing chlorine water was placed in such a way that a small portion of its surface, about one-eighth of an inch in diameter, projected above the surface of the liquid metal. On this part the solar focus from a burning-glass was thrown. The rays therefore gained access to the interior of the bulb, and were thrown about in all directions, crossing and recrossing the liquid in every way by the numerous reflections they underwent, the mercury, as it applied itself to the outer surface of the glass, acting like a spherical concave mirror, and from its mass and high conducting power effectually keeping the temperature down. The quantity of oxygen emitted in a given time was measured. The same experiment was then repeated with the bulb removed from the mercury. After the close of the same period of time, on measuring the oxygen set free, it was found that the reflecting action of the mercury had nearly tripled the effect.

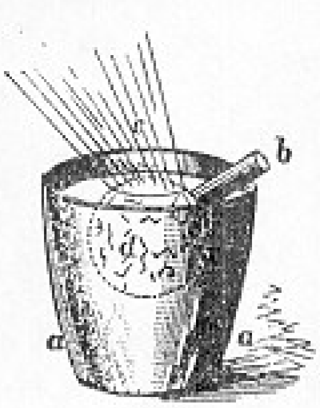


Fig. 12.

In Fig. 12, *a a*, the vessel filled with mercury; *b d*, the glass flask immersed in it, but having at its upper part a small portion uncovered, through which the converging rays, *c*, may come in.

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The power of a ray thus depending on the degree of absorption exerted upon it, I was led to inquire whether, by admixture with other suitable substances in a solution undergoing decomposition, the effect could be increased. Chlorine water decomposes more rapidly as its yellow tint is deeper. Four equal bulbs were therefore taken—*a*, containing chlorine water; *b*, the same, deepened with chloride of gold; *c*, chlorine water with commercial hydrochloric acid of a yellow tint; *d*, chlorine water with tincture of iodine. These were all exposed together to the sun. It was at once obvious that *a* was giving off most oxygen, and eventually it was found that *b* yielded a much smaller quantity, and *c* and *d* none at all. The presence of these bodies, therefore, exerted a prejudicial effect.

A system of vibrating molecules will solicit an adjacent one to execute similar motions through the medium of the intervening ether. A rise of temperature is due to an increased rapidity or intensity of the oscillations of the groups of vibrating molecules, but chemical decomposition is due to the dislocation of their parts. It, of course, by no means follows that when a compound molecule is undergoing entire disruption, those in the neighborhood should be compelled to pass into a similar state. For the very reason that chemical decomposition takes place is because the group that receives the provoking ray can not vibrate consentaneously with it; and if that group can not assume the motion in question, how can it possibly transmit it to any other?

Any artificial coloration by the addition of extraneous bodies does not increase the rate of decomposition, but retards it. This is precisely what ought to be expected. A compound atom has its *grouping* destroyed by the action of light upon its own parts, and is in no manner concerned in what is taking place in other atoms around. They therefore can not increase the effect on it, but, on the contrary, they may greatly diminish the action on the mass by exerting a special absorption themselves. Thus the chloride of gold retards the decomposition of chlorine water, when mixed therewith, in the same manner as if it were placed in a trough in front of the water, and intercepted the impinging beam.

Experiments similar to the foregoing were made with a solution of ferric oxalate mixed with alcohol, ammonia citrate of iron, tincture of turmeric, sodic chloride, etc. In every instance it was clear that the action of the light is strictly molecular, that it is impressed on the group of atoms, and not on the mass, and that when various bodies are conjointly exposed to the sun, each one undergoes its own specific change, independently of and unaffected by all the rest.

These experiments, with others of a like kind, made many years ago, have an important bearing on some recently published by Professor Vogel, Captain Abney, Captain Waterhouse, and others on imparting increased sensitiveness to collodion by mixing it with variously colored substances. I repeated their experiments as carefully as I could, and should have thought that my want of success was due to unskillfulness had I not borne in mind the foregoing considerations.

2. We may next inquire, *To what extent and in what manner is the decomposition of a compound body affected by the* FREQUENCY *of vibration of a ray?*

From the beginning of optical chemistry investigations have been made for the purpose of determining the action of rays of different refrangibilities. Almost a hundred years ago it had been shown in special cases that there is an antagonism between the opposite ends of the spectrum. Thus the phosphorescence excited in Canton's preparation by the violet end of the spectrum is extinguished by the red. As respects colored compounds, Grotthuss showed that the active ray is very commonly of the tint complementary to that which it destroys.

More recently this branch of the subject has been examined to a great extent, and the behavior of all kinds of substances in the solar spectrum made known. The general result is this, that on wave length, or, what is the same thing, frequency of vibration, the number of impulses it can communicate in a given period of time, depends the power of a ray to break down the union of any group of atoms. A compound that may resist a slow recurring motion may be unable to maintain itself when the impulses increase in frequency.

So numerous and well known are the photographic and other changes brought on by light that I need not occupy space with a description of them here. I shall only refer to some curious instances of antagonism or interference, the details of which will be found in the original memoir. Hitherto they have been very much overlooked.

Two rays may be so placed in relation to each other that their motions may conspire or may antagonize; and as one or other of these conditions ensues, the chemical result will correspond.

When iodine vapor is permitted to have access to a surface of polished silver, the silver tarnishes, the tarnished film increasing in thickness as the exposure to the iodine is prolonged. It assumes in succession colors which undoubtedly arise from the interference of the incident light with the light reflected from the metal at the back of the film. They are the colors of thin plates, like those of a soap-bubble.

Now there is a great difference in the action of light upon these differently colored films, though chemically they are the self-same silver iodide. Some have been unacted upon; in them the effect of the incident light has been destroyed or reversed by the effect of the light reflected from the back of the film. Some have been powerfully acted upon; in them the chemical effect is at a maximum—the incident and reflected rays have conspired.

If any proof were required that these maxima and minima of chemical effect arise from the superposition of similar or contrary motions, it is found in the relative thickness of the films which have been acted or unacted upon. Those in which there has been maximum action have thicknesses as 2 : 1; that showing the minimum action is 1½.

If the daylight and simple spectrum rays be permitted to act together on a daguerreotype plate, the rays of which the times of vibration are as 1, 2, etc., aid the daylight; but those of which the times of vibration are as ½, 1½, 2½, etc., interfere with it and destroy its effect.

In these numbers we may discern the suggestion of some very important facts.

One of the most striking instances of this positive and negative action I discovered in the case of the electric spark. Let there be

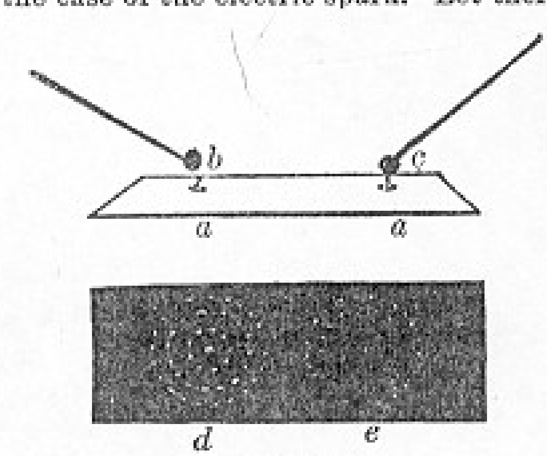


Fig. 13.

placed over a daguerreotype plate (Fig. 13) two metal balls, connected respectively with the inside and outside of a Leyden-jar in such a way that the discharge may pass from one of the balls at about half an inch distance to the sensitive plate, and from the sensitive plate to the other ball at about the same distance. One spark is sufficient. The experiment should be made in a dark room.

In Fig. 13, *a a*, the metal photographic plate; *b*, *c*, the brass balls connected with the Leyden-phial. The spark passes between them and the metal plate. At *d*, *e* the effect is shown, and again more plainly in Fig. 14.

On developing it will be found that on the point which received the spark there is a blue-white spot about one-fortieth of an inch in diameter (Fig. 14). Immediately around this an annular space which is perfectly black, the rays of the spark having there had no action; then follows a white ring, and then another black one. Finally succeeds a whitish stain of an indistinct circular form, which can be traced by inclining the plate as having a diameter of about 1½ inches.

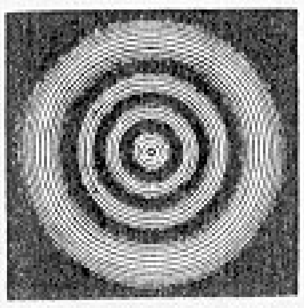


Fig. 14.

That part of the plate from which the spark escaped shows a repetition of the same phenomenon.

How shall we account for the production of these alternate white and black spaces, rings of action and inaction? Some persons might at first be led to suppose that this is only an interesting form of Priestley's experiment of "the fairy rings," formed by receiving the shock of a battery on a polished steel surface, when, by the oxidation that ensues, a film is formed of variable thickness, and giving the colors of thin plates. But a little consideration will show that this is impossible, and the facts are only to be explained on the principles of interference.

3. *In what manner is the decomposition of a compound body affected by the condition of* POLARIZATION *of the disturbing ray?*

A beam of light passing through a circular aperture one inch in diameter was received on the achromatic lens of a camera obscura, and then fell on a doubly refracting prism, so placed as to give on the ground glass two circular images of the aperture, one-third of an inch in diameter, and overlapping each other to a small extent. In these images the light was, of course, polarized at right angles respectively.

When paper rendered sensitive by being washed with ferric oxalate was placed so as to receive them, the light permitted to act nine minutes, and its effect developed by chloride of gold, the images (Fig. 15) were found of equal blackness, and the lenticular space formed by their overlapping of greater depth. This was repeated with several different photographic compounds, and always with the same result. It shows that plane polarized light acts precisely like common light, and with a rapidity proportional to its intensity.

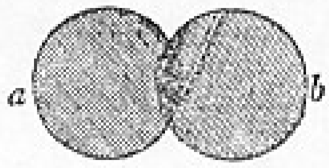


Fig. 15.

In Fig. 15, *a*, *b*, the discs of plane polarized light, polarized at right angles to each other; at *c*, the place of overlapping.

While thus attempting to detect a difference in the decomposing action of common and polarized light, I made some inquiries as to the possibility of polarizing light by a magnet.

A great many experiments have been made at different times for the purpose of producing disturbance on a ray of light by magnets. There are two methods which may be resorted to. The one hitherto followed has been to intercept the ray *in its course*, and submit it to magnetic action; but the principle on which my attempts have been founded is to attack it at its *origin*, and attempt to produce an impression on the shining body. These methods are essentially distinct. There would be a difference in trying to modify a sound on its passage through the air and by exerting some influence on the sounding body.

When Bancalari's experiment on the influence of the poles of a powerful magnet on a flame was first published, I repeated it at once, expecting that the oscillations of the shining particles were constrained to take place in one plane by the magnetism, and that the light emitted would be polarized. The result, however, did not seem to prove this.

A similar experiment was then made with the electric spark from the prime conductor of a machine. It was compelled to cross between the poles of a powerful electro-magnet. But when the magnetism was on, it did not seem that the light was polarized.

De la Rive has shown that the voltaic arc between charcoal points is greatly disturbed when it passes between the poles of a powerful electro-magnet. In the hope that this would produce the expected disturbance, I examined an arc formed between points of copper, platinum, and gas carbon; but though the sounds emitted were strong, resembling the sudden tearing of a piece of cloth, I could not perceive that the light was polarized.

In like manner the induction spark from a contact-breaker and the phosphorescent light from fluor-spar were tried without success. I still think, however, that with better means than those thus employed the experiment would succeed.

At the commencement of this paper it was stated that we should consider, 1st, the manner in which a ray of light acts in bringing about decomposition, and the changes it undergoes; 2d, the nature of the impression made on the material group, the decomposition of which ensues. The observations I proposed offering in relation to the former of these points being completed, I may pass to some remarks respecting the latter.

An examination of many cases of the decomposition of bodies by light has led me to the conclusion that its cause is to be attributed to the inability of the group of molecules affected to withstand the periodic impulses communicated to them. Of those molecules some, perhaps, take on a vibratory motion more readily than the others, and the continuance of a given group becoming impossible, a re-arrangement ensues.

But in other cases the mechanism of decomposition is undoubtedly different; a change is impressed on one of the elements acted upon, which weakens its affinity for the others. Thus, under the influence of the sunshine, plants can decompose many bodies, such as carbonic, sulphuric, and phosphoric acids.

The nature of these changes may be best illustrated by tracing the complete course through which any one of these substances passes. The chief facts may be seen in the case of phosphorus. This substance, when freshly made, commonly exhibits a white, waxy appearance, but when exposed to sunshine it turns to a deep mahogany red. If the exposure has been long continued, or the effect hastened by the action of a burning-lens, the change of aspect is very striking. It is analogous to that which sulphur exhibits when heated to 400° or 500°. I have a specimen which has been kept for many years in an atmosphere of dry carbonic acid; the sides of the vessel are incrusted with crystals, which have slowly sublimed, and which in color resemble the ferrid cyanide of potassium.

The chemical properties of these two varieties of phosphorus are very different; indeed, there is scarcely a point in which they may not be said to be unlike. The common kind shines in the dark; the red does not. The common is soluble in a variety of menstrua which do not act on the other; thus one of the methods of préparing red phosphorus is to expose a solution of the common in sulphuric ether to light—a red powder, the substance in question, precipitates. Compared together, the one displays a range of affinity which the other does not, nor do these properties seem to leave them when they are united with other bodies. Thus the active or white phosphorus, when united with hydrogen, yields a gas which is spontaneously combustible in the air; the red or passive variety yields a hydrogen compound of the same constitution, but devoid of the property of spontaneous combustibility.

It should be understood that though other agents—as a high temperature—can impress this remarkable change upon phosphorus, none can do it with more energy or more completely than the solar rays. I found by exposing a stick of white or active phosphorus to the prismatic spectrum that it is the more refrangible rays that are the most effective—those formerly termed deoxidating. Thus the rays which are most efficient in setting oxygen free from the bodies with which it is united have also the quality of impressing such a change on those bodies that they oxidize subsequently with difficulty. It follows that the true cause of such decompositions is the impression which the light makes on the elementary substance; thus if phosphoric acid be

decomposed by the solar rays, the decomposition is owing to the phosphorus being thrown into the red or passive state—a state in which its affinity for oxygen has almost entirely disappeared.

These considerations enable us to explain what takes place in the economy of plants. The water of the soil is always charged with carbonic acid, which communicates to it the quality of dissolving bone-earth; the solution passing through the spongioles goes to the leaves as ascending sap. Here it is exposed to light, the effect of which is, aided by the cell growth there taking place, to set the phosphoric acid free, and turn its phosphorus into the passive state. Its continued union with oxygen as an acid compound thus becomes impossible, and it is now associated with the proteine and oily bodies forming in the plant. Nor does it again unite with oxygen until it has passed into the systems of animals as a constituent of their nervous and muscular tissues. At the moment of activity of these, and especially of the former, it is oxidized, the change being apparently an immediate consequence of that activity, and, reverting to the acid state, it is finally dismissed from the system under the form of phosphate of soda and ammonia.

In the same manner might be explained the decomposition of carbonic acid by plants in the sunshine; for carbon, like phosphorus, and, indeed, like all other elementary bodies, has its active and passive states, as is exemplified in the contrast between diamond and lamp-black. The sunlight enables the leaves of plants to bring the carbon into the inactive state, and decomposition ensues as a secondary result. The carbon compounds arising form the food of various animals; nor does this element recover its active state until it has given rise to the processes of life, when it suddenly unites with oxygen brought by the arterial blood, and the compounds it then forms are dismissed from the system by the lungs and kidneys conjointly. It might seem that the mechanism of decomposition by vibratory movement is essentially different from that by these allotropic changes, but a more detailed examination will show that this is not necessarily so.

In the foregoing pages I have endeavored to examine how far the decomposing action of a radiation is dependent on the amplitude, the frequency, or the direction of its vibrations. The result arrived at is that decompositions are not determined by amplitude—that is, brilliancy—since a faint light continued long enough can produce precisely the same effect as the more concentrated ray of a burning-lens applied for a shorter time. Nor does the direction of motion, as involved in the idea of polarization, whether plane or circular, exert any effect, but it is the frequency of the periodic impulses that is the sole determining cause. And the phenomena of interference from the superposition of such small motions occur exactly as might have been predicted.

The immediate cause assigned for such decompositions is that a ray forcing the material particles on which it falls into a state of rapid vibration, it comes to pass in many compound molecules that their constituent atoms can no longer exist together as the same group, because of the impossibility of their being animated by consentaneous or conspiring motions, and dislocation, re-arrangement, or decomposition is the result.

In this paper I have spoken of heat and light as though they were distinct agencies, and considered such facts as conductibility, etc., displayed by the one and not by the other. But if we recall what has been said in preceding papers to the effect that these are only modes of motion, and that the difference of the effects they display turns on the character of the receiving surface or substance, there will be no difficulty in translating this commoner language into terms that are more exact, and in presenting the phenomena in question under a more rigidly scientific point of view. Familiar expressions very frequently convey to the mind clearer ideas than others which, perhaps, may be more strictly correct.

POPULAR MECHANICS

April 5, 1902.

HOW TO MAKE A BOAT FOR BOYS.

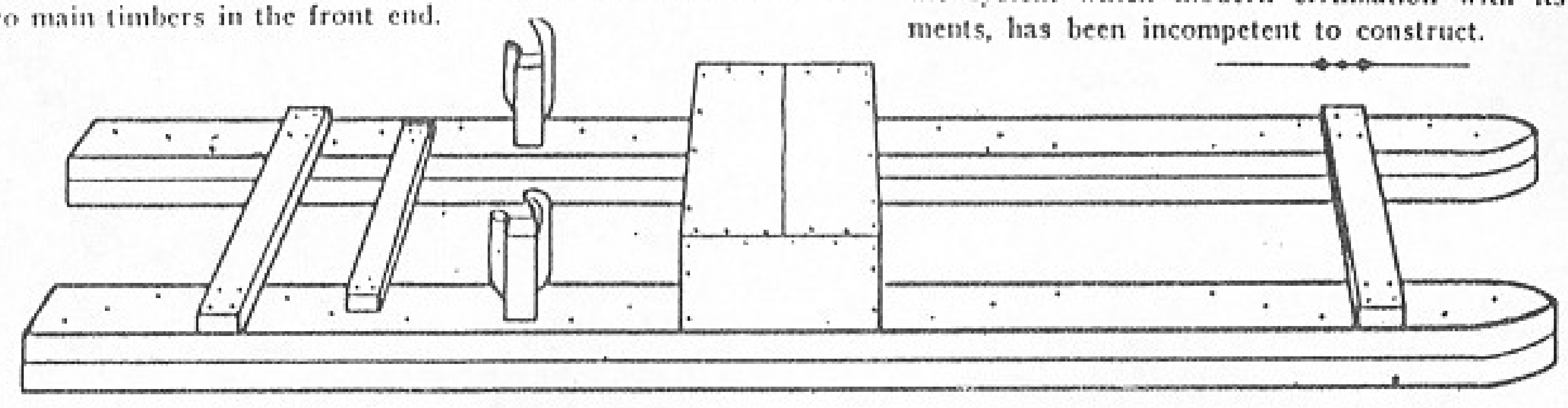
A safe, convenient and easily constructed boat for boys may be made with the aid of two logs, or heavy timbers, a box and a few boards or scantlings. Place the two logs or timbers about four feet apart on the ground. Connect them by a couple of strong cross pieces, as shown in the illustration. That the cross pieces be fastened more securely to the timbers it is better to attach them by boring holes in them and the timbers with an augur, and driving pegs in the holes. The pegs should be driven in at each end of each cross piece. The oarsman's seat may be made of a box or boards as you desire. Make the oak locks by hollowing out a piece of thick board and fastening it securely to the timbers either by large nails or by sharpening the lower end and driving it into an augur hole. Brace the oar locks to the sides of the timbers and to the foot brace. The oars can be made of any kind of boards or strips. Such a boat to accommodate one boy may be made of a couple of railroad cross ties. By obtaining larger timbers it can be used by a number of boys. The device will give better service by sharpening the two main timbers in the front end.

IRRIGATION OF THOUSANDS OF YEARS AGO.

Discoveries Which Prove the Great Inferiority of Modern Civilization.

Thousands of years ago, it is claimed, there existed in New Mexico a system of reservoirs, irrigation and viaducts that is unparallelled at this age. This is proven beyond a doubt by discoveries and investigations that have recently been made. Under the lava which covers hundreds of square miles are found traces of cement ditches and reservoirs that are marvels of engineering.

In those days, says the Rural Californian, the deserts bloomed like a garden and a civilized race of millions occupied the arid Southwest. Our irrigation engineers have much to learn from the people older than the Pueblo race, who inhabited New Mexico when the race from which Columbus sprang were still barbarians. In those days reservoirs at convenient basins stored the water, which was led in cemented ditches across the loose soil to where it was needed for use. Chasms were crossed by viaducts. Into some of the ditches lava has run, showing their great antiquity. Others are covered with shifting sands, but enough are visible to enable skillful engineers to understand the system which modern civilization with its boasted attainments, has been incompetent to construct.



A SAFE BOAT BOYS CAN MAKE.

Foundry Work

MOLDING SANDS. FOUNDRY BLACKINGS. MOLD MAKING. THE ODDSIDE. RAMMING. VENTING. RUNNERS AND RISERS. CORES. PATTERNS. BEDDED-IN MOLDS. LOAM MOLDS. FALSE ODDSIDES. PLATE MOLDING. MOLDING MACHINES. MULTIPLE MOLDS. MACHINE-MOLDED GEARS. MENDING-UP. PERMANENT MOLDS. MELTING IRON. POURING. FETTLING. MALLEABLE CASTINGS. CHILLED CASTINGS. NON-FERROUS METALS. GLOSSARY OF FOUNDRY TERMS.

Machine Shop Practice — 1941

See also Survivor Vol. 1, page 58

A LARGE part of the work done by the man in the machine-shop has to do with castings of one kind or another, and it is necessary, therefore, that he should have at least some knowledge of the way in which they are produced. This chapter does not pretend to be a technical treatise on every aspect of the foundry; it is written more for the man who would like to know the general principles underlying the manufacture of castings.

An Old-Established Industry

The founding industry is probably the oldest branch of engineering, and it is certainly one of the most important. It was practiced by the craftsmen of the ancient Greek and Roman civilizations, and even earlier, and crude examples of the founder's work have been excavated from many ancient sites. Although modern methods have transformed it from a crude art into an exact science, it is interesting to note that the basic principles remain unchanged, and the molder of today uses methods very similar to those employed by the ancient founder.

Castings are made from patterns which are an exact facsimile of the article to be produced. The patterns are pressed into sand, and when removed leave their impression. Into this sand impression, or mold, molten metal is poured and allowed to cool. When it is removed it will be of the same shape as the mold, only slightly smaller owing to the contraction of the metal.

Before explaining how the mold is made, we will discuss the sand from which it is made.

Molding Sands

Molding sand must possess six main characteristics—porosity, plasticity, adhesiveness, cohesiveness, refractoriness, and strength when heated. It must be porous, in order to allow of the escape of any air, gases, or moisture present or generated in the mold when the hot metal is poured into it. It must obviously be plastic so that it can be shaped to the form of the pattern. It must be adhesive—i.e. capable of attaching itself to another body—so that it will cling to the sides of the box or flask in which it is molded or to the supports provided in the flask for the purpose. Cohesion—or the ability of the particles to stick together—is necessary to allow the pattern to be removed without breaking the mold, and also to stand up to the flow of the molten metal as it enters the mold. Moreover, it must retain its cohesion on becoming hot. Refractoriness, or resistance to fusion by heat, is an obvious requirement in molding sands, for they have to stand exceedingly high temperatures and yet retain their stability. Moreover, a sand that is not refractory would affect the face of the casting and make it difficult, if not impossible, to machine.

Very few natural sands possess all these qualities in the right proportions, so it is usual to make up the deficiency of a sand in any particular characteristic by mixing it with other sands or substances which possess that characteristic to a high degree. Most of the substances added to make up any deficiencies consist of loamy sands or sandstone which is crushed especially for the purpose. Some sands can be improved by mechanical means such as grinding, a process which will be explained later in this chapter.

Size and Shape of the Grains

The size and shape of the grains in any particular sand have a large bearing upon its strength and general character. Sands in which the grains are round are weaker than those in which they are sharp and irregular, because the round grains do not interlock or overlap with each other, whereas sharp, irregularly shaped grains do, especially when rammed together, forming a much stronger structure. Sharp-grained sands, having less clayey matter in their composition are often more porous and more easily vented—i.e., it is easier to make provision for the escape of the air and gases in the mold.

The size of the grains is also important. If the grains are large and regular in shape and size, the sand will be more porous than if the opposite were the case. Grains of equal size and irregular or angular in shape also favor porosity, while grains of unequal sizes and smooth surfaces do not, although they give a strong sand.

The size of grain does, of course, determine the smoothness of the mold surface, and for that reason large-grained sands are generally unsuitable when castings with very smooth skins are required. This difficulty can be overcome by using a fine sand on the face of the mold.

Some Natural Sands

Sands suitable for foundry work are found in several places. Natural sands which are suitable for foundry use are found in the vicinity of Albany, New York; Sandusky, Ohio; and Ottawa, Illinois, as well as other places. They are generally known merely as molding sand, and usually contain about 85 percent silica; about 8 percent alumina (clay) and the balance magnesia and other minerals. They are generally classed as (1) Sharp grained river sand, (2) Round grained lake sand. The difference has been explained in the previous paragraph.

Sand Mixtures

Molds may be poured while moist,

or they may be dried out in an oven before the metal is cast. These are known respectively as *green-sand* and *dry-sand* molds, and the sand mixtures used vary considerably. We will first of all consider green-sand mixtures.

For green-sand molds various materials are added to the natural sand with a view to making it more refractory. These substances separate the grains, thus making them less liable to burn together when they come into contact with the hot metal. They also make the sand more open, and allow the steam and gases to escape more readily from the mold.

Uses of Coal-Dust

Coal-dust is perhaps the most widely used substance, which accounts for the fact that most molding sand is black in color. Powdered charcoal, coke-dust, and anthracite are also used. These substances tend to make the sand more open, but at the same time they impair its cohesiveness and render it weaker. It stands to reason, therefore, that the mixing has to be done with extreme care. The addition of coal-dust is of great value in helping to cool the mold after it has been poured, for as soon as the molten metal comes into contact with sand containing coal it dries the face of the mold and begins to heat the sand. The coal-dust immediately gives off gas, the liberation of which, combined with the conversion of the water in the sand into steam, absorbs heat and cools the sand, thereby preventing the grains from becoming overheated and fusing. The amount of coal-dust used in molding sand varies not only with the character of the sand, but also with the type of work.

Moisture Content of Sand

The amount of moisture in a molding sand has a considerable effect not only upon the making of the mold, but also upon the behavior of the sand when the metal is poured. A mold may be perfect in all other respects and yet the casting may turn out to be a reject on account of the sand being too damp. Damp sand when rammed tight will not retain its porosity so well as drier sand; hence, the drier the sand that can be used without losing its cohesion, the better it will be.

It is impossible to give any hard-and-fast rules for the correct moisture content, because different sands require different amounts of moisture to enable them to be used; but the experienced molder will be able to determine for himself the quantity that gives the best results. In large foundries where a chemist is employed, the sand will be mixed under his supervision and delivered to the molders in the best possible condition.

This much, however, can be said: too little is better than too much, for there is nothing that will produce poor castings and castings with blowholes more readily than large quantities of steam in the mold, however well it may be vented.

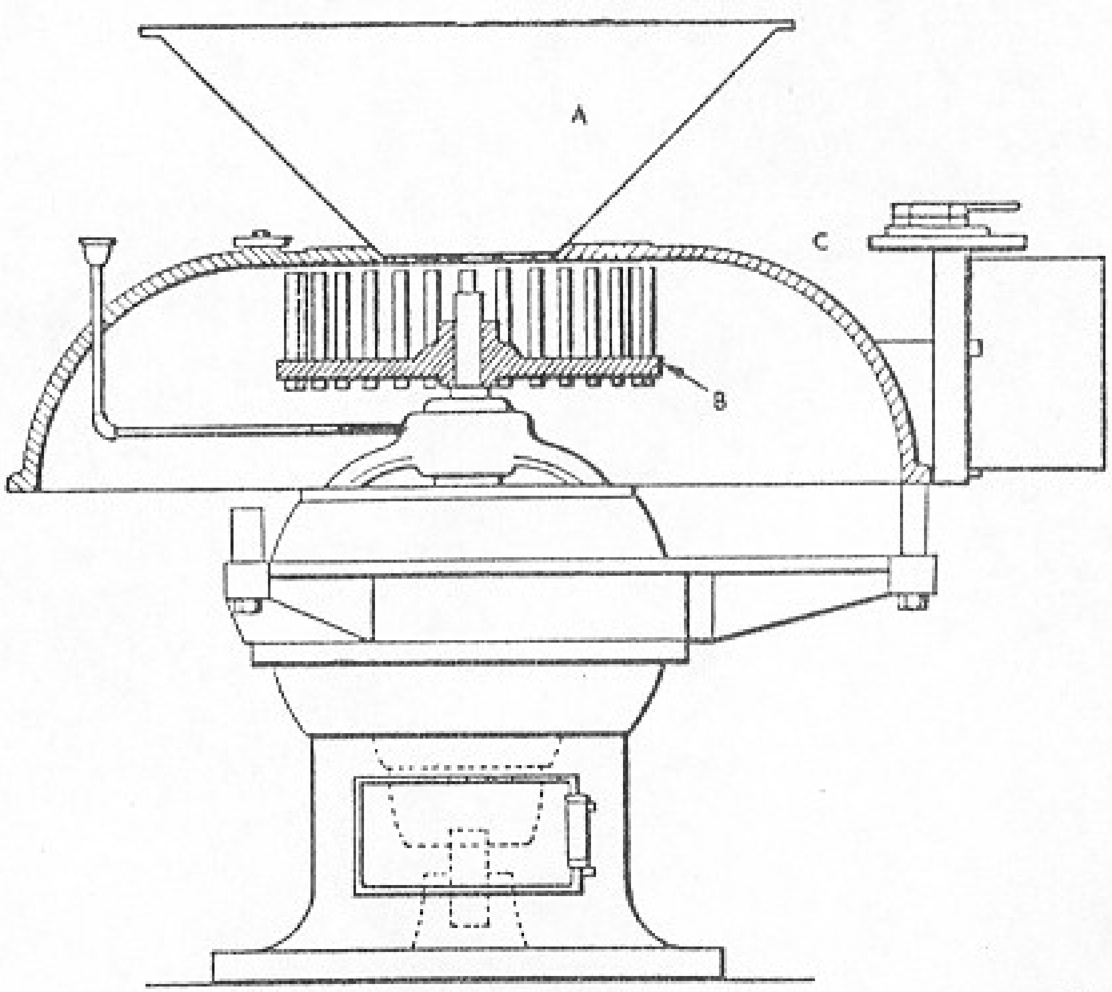


Fig. 1. A centrifugal sand-mixing machine. The sand, with any necessary additions, is thrown into the hopper *A* and falls to the plate *B* which has a number of vertical prongs bolted to it. This revolves at about 1500 revolutions per minute. The sand is thrown out of the machine through the plate C. A thorough mixture is obtained in this way.

Facing Sand

The purpose of facing sand is to form a smooth surface and prevent the mold from being washed away by the flow of the molten metal when pouring takes place. Facing sand is placed next to the pattern, and is then surrounded by used molding sand. Since it is the most important portion of the mold, this sand is usually composed of a mixture of high grade molding sand and carbon dust. The carbon dust is generally about 10 percent of the total volume. It is not possible to give mixtures for every type of work, but broad principles may be laid down. The first of these deals with the mixing. The various ingredients must be thoroughly intermingled. It is advisable as a rule to do the mixing in a separate shed with a good clean floor. Where more than one kind of sand is being use, they should be kept well apart to avoid the possibility of their getting mixed accidentally.

Where large quantities of sand are being mixed by hand, several men should be put on the job. In mixing the ingredients they should be spread in layers to form a mound finishing with the ingredient that is used in least quantity. The laborer should take a vertical slice from the mound and mix it well on the floor. The process should be continued until the mound has been used up.

Sand-Mixing Machines

In modern practice, especially when there are large quantities of sand to be mixed, mechanical mixers are employed. Fig. 1 shows a machine of this type.

Core Sand

Core sand differs from molding sand in several respects. First, it has to be handled when removed from the core-boxes, before being baked so it must be very adhesive. As cores are to a large extent surrounded by metal, it must be very free venting, otherwise the gases will be unable to escape, and blown castings are sure to result. This trouble is to a large extent removed by the fact that cores are usually dried, and consequently more porous than in the damp state. The difficulty is to retain sufficient cohesion after drying to enable them to be handled and withstand the pressure of the metal which is poured into the mold.

Additions to Core Sand

Various additions are made to core sand in order to make it meet these requirements. These include gums of various kinds, flour, powdered rosin, and oils of various descriptions. Syrup and water mixed, and even beer, are sometimes used. Core sand must not be mixed too wet, or it will adhere to the sides of the core-box, especially if the box is a wooden one, and rough cores will result. Small cores should be made with a finer sand than large ones, although the type of casting will determine this.

Dry-Sand Mixtures

Dry-sand molds are dried in an oven before the metal is poured into them, and consequently the mixture of the sand varies somewhat from that used in green-sand molds. Only the heavier types of sand of a close clayey texture will retain their coherence when dried. The usual green-sand mixtures would pulverize and break up under the action of the heat.

Horse manure, straw, or cow hair is frequently added to dry sand to render its otherwise close texture sufficiently open for venting. Dry-sand molds are made in much the same way as green-sand ones (to be described later), but, being dried before pouring, less gas is generated, and they are therefore safer. The face of the mold is generally thoroughly blackened before drying.

Parting-Sand

Parting-sand is used to prevent the surfaces between the halves of a mold from sticking to one another when the two parts of the flask are separated. It also prevents the sand from sticking to the pattern. It is sprinkled on the surface of the drag before the cope is rammed up, as will be described later.

It is composed of burnt sand, pulverized blast furnace slag, brick dust, or very fine grained sand. It is important that it should not contain any material which would draw or retain moisture. It may be sprinkled on by hand or shaken from a bag.

Facing

In order to prevent the molten metal from coming into actual contact with the sand on the face of a mold and producing sandburns on the face of the casting, the mold is frequently painted or dusted. Various substances may be used for this purpose, including charcoal, lamb black, coke dust, plumbago, black lead, or graphite. These substances, which are all more refractory than the molding material, are nearly all some form of carbon. They may be applied wet or dry, according to the nature of the mold, and for use in the wet state some adhesive is employed, clay, gum, syrup, and other substances being mixed with the water used. When applied wet, they are usually painted on to the mold with a brush. Facing used dry is dusted over the face of the mold.

All facings must, of course, be fairly porous, for they must not close up the pores of the mold.

Making the Mold

Molds are made in sand from patterns which are the exact facsimile of the article to be produced. They are slightly larger, in order to allow for the shrinkage of the metal on cooling and for any later machining that may be necessary. The patterns are pressed or buried in the sand, and when removed leave their impression. Into this impression molten metal is poured and allowed to cool. When it is removed it will be found that it will be of the same shape as the mold, only smaller owing to shrinkage. This is allowed for in the pattern.

While it is a simple matter to press or bury a pattern into the sand, to remove it presents some difficulties. In order to make this easier, molds are usually made in a box in two or more sections, the former being the more common for most types of work.

The boxes in which the molds are made are known as flasks. These consist of frames of wood or metal, two such frames being required to make a mold. These boxes fit accurately together, and are provided with pins to insure an exact fit when they are put together. The accuracy with which these parts fit is of the greatest importance, as will be seen later. Any displacement of the parts will produce inequalities on the surface and in the thickness of the casting.

Fig. 2 shows a simple type of two-part flask. The part, A, is the top, or cope; B is the bottom, or drag; the bars, C, are provided to locate the two halves of the box, and the handles, E, are used to lift the boxes.

Making the Oddside

In making the mold, the cope is placed joint upwards on the bench or floor and strickled off roughly. The pattern is then embedded in the sand up to the joint, which is usually somewhat about the half-way line. At this stage the cope is used only to support the pattern while the drag is rammed and the joint made. This support is

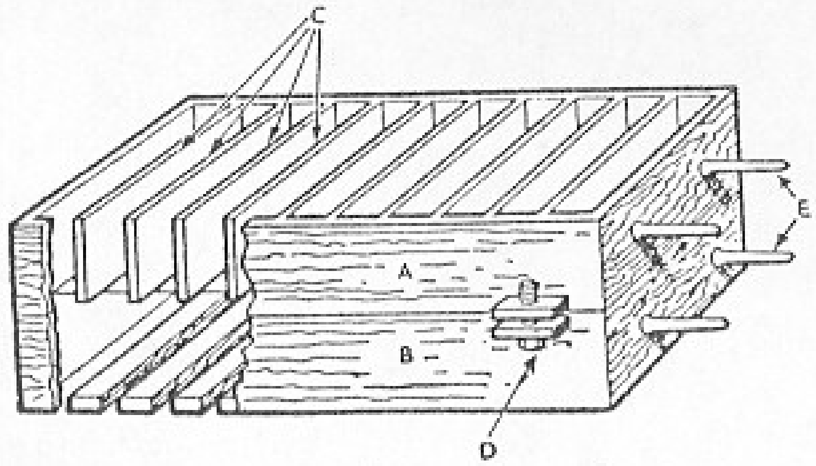


Fig. 2. Simple type of two-part molding-box, consisting of a top, or cope, *A*, and a bottom, or drag, *B*. The bars *C* are provided to retain the sand in the box. The two parts are held in register by means of the pin *D*. The handles *E* are for purposes of handling.

known as the oddside.

The drag is now placed on the cope, and facing-sand sieved on to the uncovered part of the pattern. This sand is rammed evenly round the pattern, special care being taken to avoid hitting the latter with the rammer. This, apart from causing possible damage to the pattern, would be detrimental to the mold owing to uneven hardness on the surface.

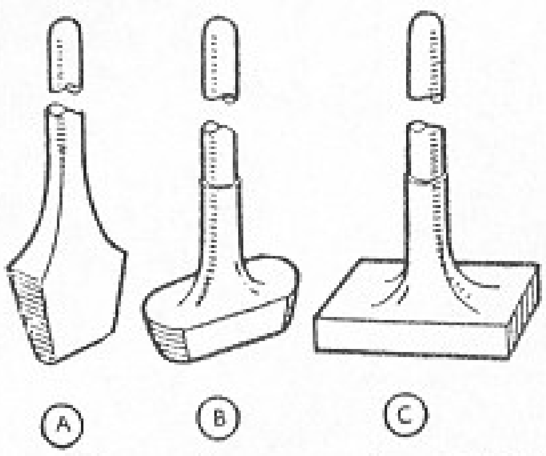


Fig. 3. Types of rammers in general use in the foundry. *A* and *B*, two forms of pegging rammers used for general ramming; *C*, flat rammer used for final ramming.

Ramming

The object of ramming the sand is to consolidate it, thereby preventing the cavity of the mold from being enlarged by the pressure of the metal without making it so hard as to obstruct the free passage of air and gases escaping from the mold. The sand must be rammed evenly and to the same density all over, otherwise the metal may swell at the soft spots and produce a casting that is not true to pattern. Again, if any part of the face is rammed too hard, the gases may stay in the metal and cause blow-holes in the casting. If hard ramming is necessary it must be done not on the facing sand, but on the sand behind the face, and the dangers arising from it prevented by the free use of the vent wire, for the harder the ramming the more the venting that will be necessary. Fig. 3 shows three types of rammers in common use.

When the facing sand round the exposed part of the pattern has been rammed, floor sand, or backing sand, is added to fill the drag to the top. This is rammed up evenly all over and may be rammed somewhat harder than the sand on the face.

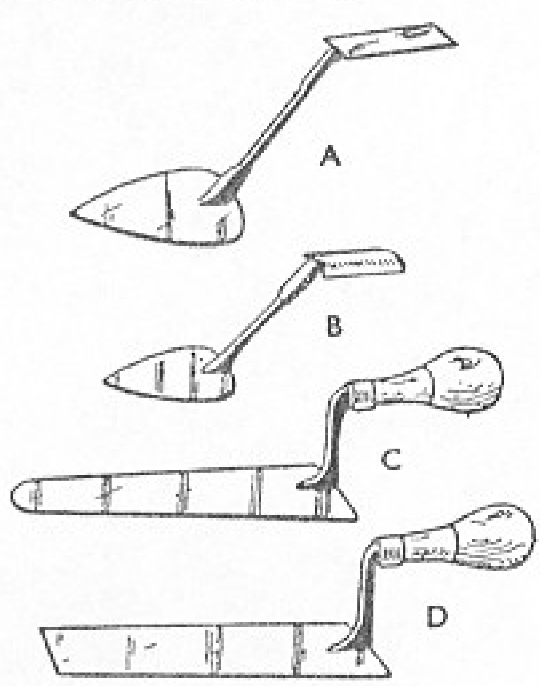


Fig. 4. Trowels used in making molds. *A*, heart-shaped trowel; *B*, gate knife used for cutting gates and runners; *C* and *D*, two types of trowel used for purposes of jointing.

The flask is then turned over, the cope being now on the top and the drag beneath it. The cope is lifted from the drag and the sand knocked out. The joint must now be carefully made and troweled smooth, great care being taken with the sand near the edge of the pattern. It is sometimes as well at this stage to lift the pattern very slightly to make sure that it does not lift the sand at the edges with it.

Use of Parting-Sand

Parting-sand is next dusted over the surface to prevent the two halves of the flask from sticking when they are separated for the removal of the pattern. The cope is replaced on the drag, and facing-sand riddled into it, as was done in the case of the drag. When rammed, backing-sand is added as before and rammed up evenly all over.

The pattern is now completely buried in the sand, but before the two halves of the flask are separated for its removal, provision must be made for the free escape of gases and steam that will be generated when the hot metal comes into contact with the damp sand. The method of venting varies with the weight of the casting and the nature of the mold, small castings being frequently cast without any vents at all, whereas in very heavy ones numerous vents may be necessary.

Venting

Broadly speaking, venting consists of providing holes from the top of the flask to within about one-eighth of an inch of the mold-face. They are usually made with some form of thin wire, which is pushed through the sand, and which, when withdrawn, leaves channels for the free passage of air and steam contained in, and generated by, the contact of the hot metal with the mold. The need for careful venting is due to several causes: the expansion of the air contained in the pores of the mold, steam and gas caused by the water vapor coming into contact with the hot metal, on the coal dust and other ingredients of which the sand mixture is formed.

When the venting is completed, the cope and drag may be separated. This is a very delicate operation, and must be done with great care. If the joint

has been properly made it will be found that, when the cope is lifted the pattern is left in the drag, from which it must now be removed. It may sometimes be found necessary before lifting the pattern to loosen it by rapping it gently. This usually makes it separate cleaner and more easily. The operation of removing the pattern is known as drawing.

Cutting the Runner

We now have the two separated halves of the flask each containing the impression of half of the pattern, but before the mold can be finally closed a runner, or channel, for the metal, must be cut through the cope to the mold. There are various means of doing this, perhaps the most common being by pushing a piece of thin tubing through the cope from the mold-face outwards. This removes the sand in much the same way as an apple-corer removes the core from an apple. In certain cases the runner is rammed up with the cope. This is done by inserting a piece of round stick into the cope while the ramming is being done, and afterwards removing it when the parts of the box have been separated.

Runners may be led directly into the mold, or they may be placed some distance away and a channel cut from them to the mold at the most suitable spot. The channels from the runner to the mold are known as *gates*. The position of the runners and gates will be determined by the type of casting, but as a general rule they are so placed that they can be removed from the finished casting with the least amount of trouble.

Risers

On some molds risers are cut. These are provided for in exactly the same way as the runners, and their purpose is to remove any dirt or slag formed by the oxidation of the metal from the mold. The metal when it is poured runs through the mold and out through the riser, taking any dirt or sand with it. Risers, like runners, may be led off directly from the mold, or they may be connected with it by gates. The metal contained in the riser serves as a feeder when the metal in the mold shrinks in cooling. This makes a better casting. Fig. 5 illustrates a section through a mold showing both these channels.

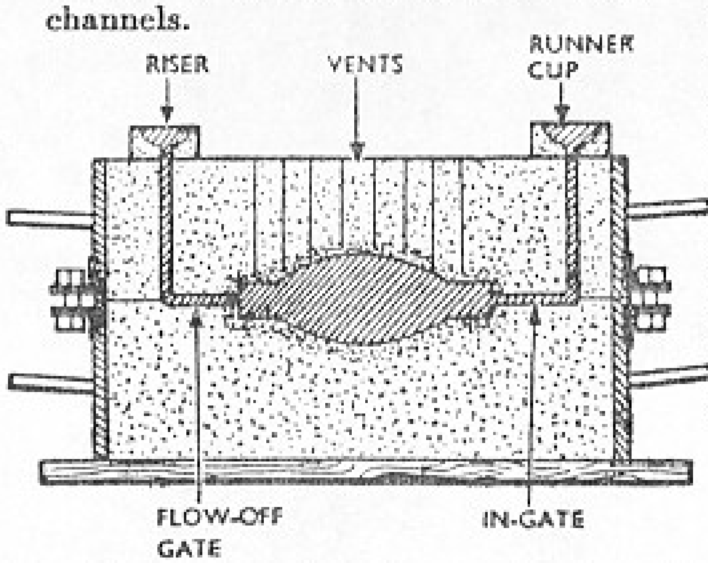


Fig. 5. Section through completed mold showing the runner, down which the metal is poured, and the riser, which is provided to rid the mold of dirt, etc. The channels cut from the runner into the mold and from the mold to the riser are known respectively as in-gates and flow-off gates.

In order that the metal may be poured easily down the runner, a runner cup or basin is cut either directly into the sand in the top of the cope or in a separate box used for the purpose. This acts as a funnel into which the metal is poured, and provides for a constant flow of metal to the mold. A section through such a cup is illustrated in Fig. 6.

It should be noted that, if molds are not cast immediately they are closed, some form of covering should be placed over the runners and risers to prevent any sand or other material from finding its way into the mold via these channels. This would obviously be detrimental to the casting.

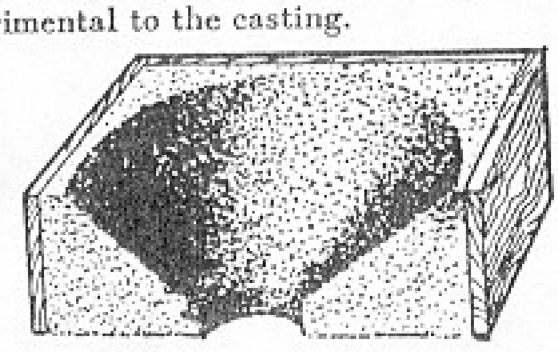


Fig. 6. Section through runner cup, or sand funnel, through which the metal is poured into the runner. It may be made in a separate box or hollowed out in the sand of the cope.

When the mold has been closed it is ready for casting, but before the actual pouring is done it is necessary to clamp, bolt, or weight the two parts of the flask together, so that they cannot be forced apart by the pressure created by the head of metal in the runners and risers. This may be considerable, and in big castings may run into tons. Should the mold lift, the metal will escape through the joint and ruin the casting. Another result might be that the casting would be thicker and not true to pattern. Fig. 7 illustrates the general arrangement of a mold ready for casting, with runner-cups and weights in position.

Cores

The mold described above is of the simplest form, producing merely a solid piece of metal. Many castings are more complicated and have hollow portions, sometimes of very intricate design. The water-jacket of an internal-combustion engine is a good example. Whether simple or intricate the hollow portions are made by inserting cores into the mold to form the exact shape of the hollow part of the casting. These cores are made of sand. It stands to reason that damp sand molded into any particular shape would not possess sufficient strength to be handled easily. The cores are, therefore, frequently reinforced, and special binders are added, as already described, which, baked, give additional strength.

Core-Boxes

Cores are made in boxes. These are somewhat similar to the flask in principle, but are usually made from solid wood. They are made in two or more parts into which the sand is rammed. The core-box is in fact a mold, and the process of making a core is the exact reverse of that entailed in making a mold.

After ramming the sand into the core-box, the two halves are separted and the core is turned out. It is then placed in an oven and baked, after which it is ready to be placed in the mold. Fig. 8 shows a simple core-box together with the core that has been made in it.

The cores rest in the mold in recesses especially made for the purpose. These recesses are added to the pattern in the form of projections known as core-prints. Fig. 9 illustrates a sim-

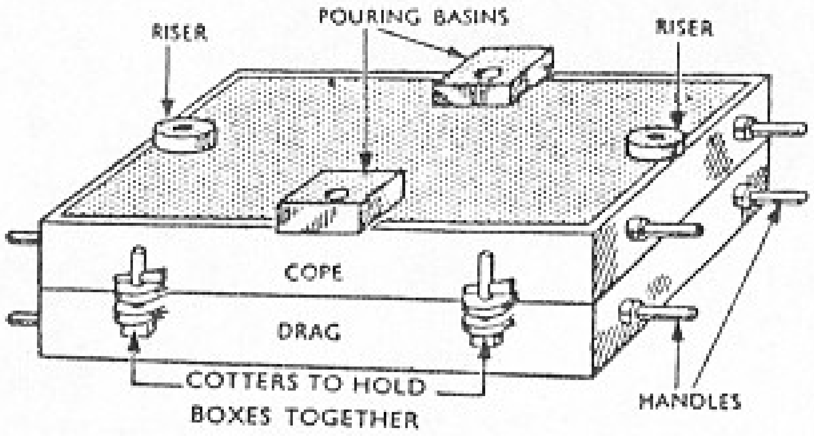


Fig. 7. General arrangement of a mold after it has been closed and is ready for casting. It is provided with two runners and two risers, and the two parts of the flask are cottered together to prevent them becoming separated by the head of metal in runners and risers. On many jobs weights are used in place of the cotters.

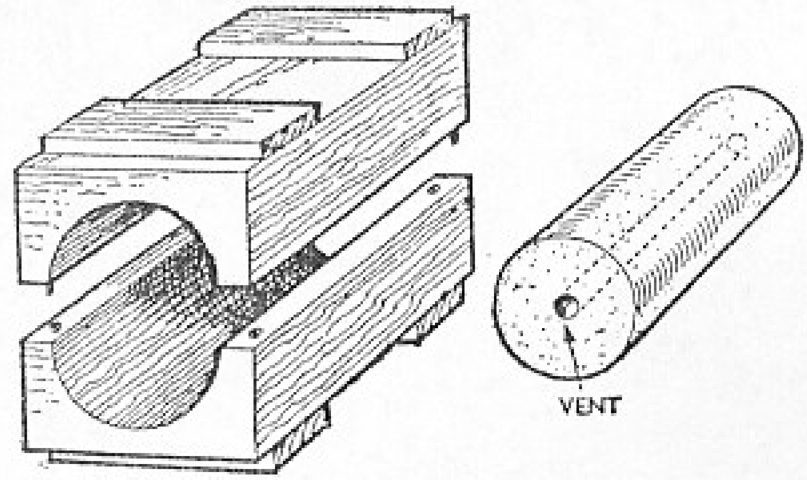


Fig. 8. *Left,* simple core-box made in two parts, used for the production of cylindrical cores. *Right,* core as it would appear when removed from the box. Note the central vent.

ple pattern with core-prints and also the impression left by these prints in a sand-mold.

Venting of Cores

Although cores are thoroughly dried out in an oven before being placed in the mold, it is still necessary to provide means of escape for the gases generated when the metal comes into contact with them. Venting is of extreme importance so far as the core is concerned, for the larger part of it is often entirely surrounded by metal, and any gas failing to get away through the vents will stay in the metal, thus causing blow-holes.

A core is vented in a similar manner to a mold—that is to say, it is provided with channels through which the gases escape. These are made in the core in its green, or damp, state by pushing a wire through the center. Where the core is not straight, string is frequently rammed up in the box with the core and removed when the core is completed, but before it has been removed from the box.

Use of Wax String

It is essential that molten metal cannot find its way into these vents and block them up, as this might result in the bursting of the core, owing to the fact that the gases have no free means of escape.

With very intricate cores the venting is frequently done by means of wax-coated string. The wax melts when the core is in the drying oven, and when it is removed the strings can easily by pulled out.

Cods

Strictly speaking, a core is any portion of a mold which produces a hole through or a hollow in a casting, and although most cores are made entirely separate from the mold, hollow parts in a casting are often produced by upstanding parts left in the mold when the pattern is drawn. These projecting portions fulfill the functions of cores, and are known as cods.

Where large cods are left behind in the mold when the pattern is drawn they may have to be reinforced with wires to prevent them breaking away.

It is usually desirable to arrange the mold in such a way that the cod is left in the drag. This is done for the simple reason that it is obviously easier and safer to draw the pattern upward from the cod than to draw the cod away from the pattern in the cope. In machine molding, dealt with later on, turn-over machines are used in cases where large cods have to be drawn.

Patterns

A pattern is a facsimile of the casting to be produced, and its manufacture calls for a very high degree of skill on the part of the pattern-maker, as well as a sound knowledge of foundry practice. The pattern-maker decides the manner in which the casting is to be molded and where the joints are to be made in the mold.

The first requirement of a good pattern is that it should be removed from the sand without disturbing the mold. To achieve this the faces are tapered slightly, the taper in use being generally about 1/8 in. to the foot. When the shape of the pattern is such that the taper will not work, as in a pattern that is wider at the bottom than at the top, then *loose pieces* or cores are used to meet the particular case. These loose pieces are fixed to the pattern by means of pins, which are removed as soon as the sand has been rammed round the loose piece to hold it in position in the mold.

Loose Pieces

When the pattern is drawn, the loose pieces are left behind in the sand and drawn out into the cavity left in the mold by the removal of the pattern. See Fig. 10.

Generally speaking, patterns are made of wood, but where very large numbers of molds have to be made from a single pattern, as in the case of mass-production jobs, metal patterns are used. These have a highly polished surface to make them draw easily.

Core-Boxes

Core-boxes and patterns are sometimes made together in one piece, the pattern being made in two parts and hollowed out inside to form the core-box. These dual-purpose patterns, however, are only used in small types of work and never in repetitive jobs.

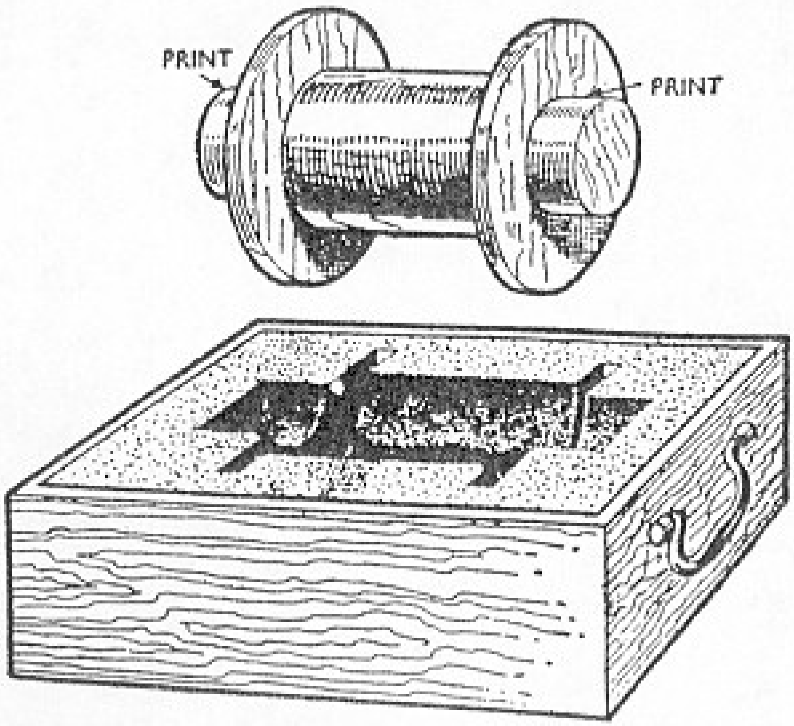


Fig. 9. *Above,* simple pattern with core-prints. The core fits into and is supported by the impressions left in the sand by these prints. *Below,* impression left by the pattern.

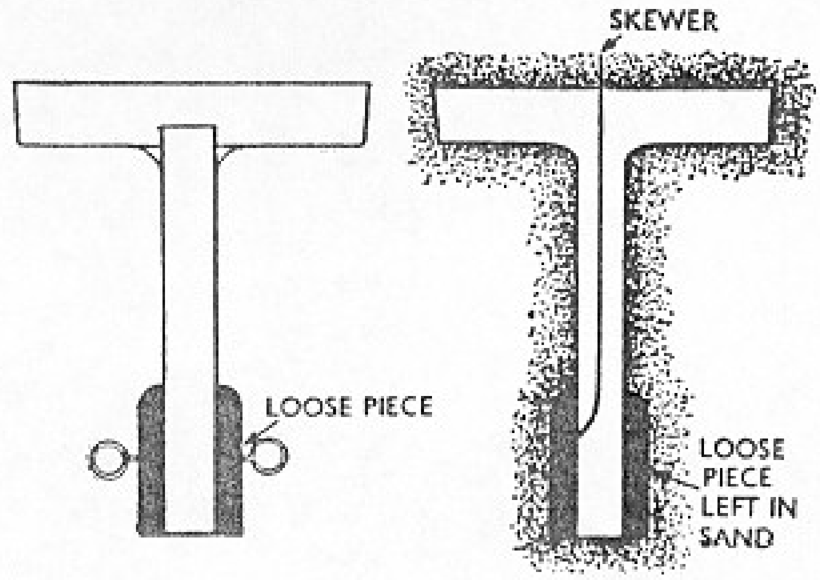


Fig. 10. Where patterns must be of such a shape that they cannot be drawn from the sand owing to projections, loose pieces are employed to get over the difficulty. These are detachable from the pattern and drawn separately after the pattern has been taken from the mold. *Left,* pattern showing loose pieces; *right,* the loose pieces being removed from the mold by means of a skewer.

Care of Patterns

Patterns are expensive to make, and should be handled carefully if they are to be maintained in good condition. They must be stored in a properly ventilated building where the temperature is even, otherwise they may warp and become unserviceable.

It is best to number each pattern, together with its loose pieces, if any, and core-boxes, store them in a rack with the number painted on the outside. In this way much time may be saved in finding the pattern when it is wanted. When patterns come from the pattern-maker they have a smooth surface. Frequent use in the foundry will, in time, tend to roughen them, so it is desirable that they should be looked over periodically and treated, if necessary, with applications of varnish or shellac.

Other Types of Molds

Very heavy castings, or castings of a considerable depth or area, may be molded in the foundry floor. In such cases the floor itself acts as the drag, and this may be covered with a cope, or the mold may be cast open. Open sand castings usually have a very rough surface, and only castings in which this is not important are made in this way.

It stands to reason that when molding patterns in the sand of the foundry floor, the lower faces of the mold which are formed underneath the pattern cannot be easily rammed, for, unlike molds made in a box, there is no means of providing an oddside.

Preparing the Bed

In making a bedded-in mold a smooth surface is first made on the sand and the level carefully checked. The sand is then dug up and loosened to a sufficient depth and the pattern beaten into it with heavy wooden mallets. The pattern is then removed and an inch or two of facing sand riddled into the impression. The pattern is then replaced and beaten down again. The sand round the pattern is then thoroughly packed with the rammer, after which it is smoothed off and the joint face made ready to receive the cope. Parting-sand is then dusted over the joint and the cope rammed up in the normal manner. The mold is then opened, the pattern removed, and runners and risers cut as for box-molds.

Bedded-in molds have to be made with great care, for it is a difficult matter to make the lower half of the mold of even density all over. They call for considerable skill on the part of the molder, because if the sand is of unequal density, the metal is liable to swell over the softer portions and produce castings that are not true to pattern. The lower half of a bedded-in mold is difficult to vent, and consequently the best type of sand for use with this work is one which possesses a large proportion of sharp sand of a free-venting type. Cinders or other such loose material are sometimes placed beneath the mold.

Loam Molds

Where a mold has to be modeled to the required shape without the use of a pattern or with patterns only of such portions as depart from the general sectional form, some sort of plastic material, possessing considerable adhesiveness, must be used. Clayey sand, or loam, is used for molds of this type. The wet loam is daubed on to brick supports built up in the rough shape of the mold, and, in addition, iron plates and supports are used to give it sufficient strength and rigidity to stand up to the weight of the metal when poured. The mold is thoroughly dried before pouring takes place.

The apparatus used in the produc-

tion of these molds is simple, and consists of spindle bars, striking-boards, and the like, which are used in shaping the mold. The making of loam molds calls for great skill.

Molds of this type are generally used only for very heavy castings or in cases where the cost of the pattern for a single mold would be prohibitive. Fig. 11 shows plan and sectional views of a loam mold in course of construction. A is the striking-bar. B the striking-board. C socket for striking-bar, and D the loam-bricks forming the skeleton of the mold.

We have explained earlier in this chapter that an oddside is the support upon which the pattern stands while the drag is being rammed up, and shown how this may be made in the cope, the sand being knocked out after the drag has been rammed.

Sometimes, however, false oddsides are used to save the time and trouble in- volved in having to make a fresh sand oddside for each mold.

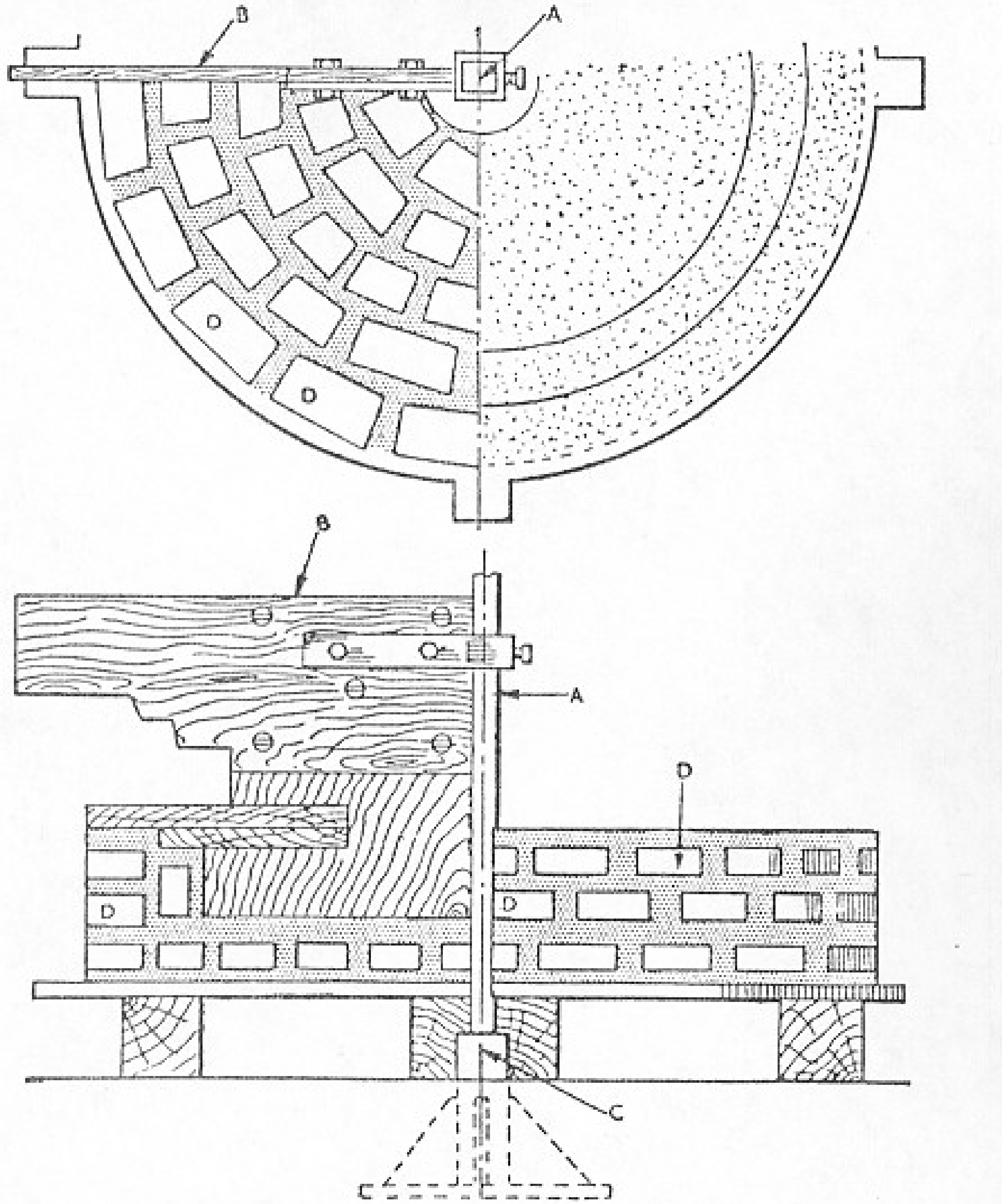


Fig. 11. Loam mold in plan and section. These molds are built up from loam, or clayey sand on a skeleton structure and modeled to the required shape by means of striking-boards. Usually very large molds, where the cost of a complete pattern would be prohibitive, are made in this way. They are thoroughly dried out before pouring begins. The letters indicate, *A*, striking-bar; *B*, striking-board; *C*, socket for striking-bar; *D*, bricks forming skeleton of mold.

False Oddsides

These false oddsides may be made of several substances. They may be of clayey sand blackened or painted on the surface, or of plaster of Paris. The latter substance is perhaps the more suitable, as it will stand up longer against wear and is less likely to become chipped or damaged. These oddsides do not form part of the mold, but only assist in the molding operations.

Plaster oddsides may be made as follows. A drag is filled with sand and strickled off. The pattern is then bedded in up to the joint and the sand carefully sleeked. A cope is then put on top of the drag, and graphite or some similar substance dusted over the pattern to prevent the plaster from adhering to it. A suitable mixture of plaster may now be poured in to cover the pattern. It need not fill the box, being poured only to a depth which is sufficient to withstand ramming.

When the plaster has set, the cope may be removed, when it will be found that a plaster impression of one half of the pattern has been left. This may be reinforced on the underside by means of wooden struts, if necessary.

When making a mold by this means, the pattern is first placed in the oddside, and the drag put on top and rammed up. The boxes are then turned over and the oddside removed. If only one false oddside is used, the second half of the pattern is rammed up in the usual way.

Use of Two Oddsides

Frequently two false oddsides are used in making a single mold—one for each half. This considerably reduces the molding time, especially in the making of the joints.

It will be realized, when the following section on plate molding has been studied, that false oddsides very much resemble pattern plates in their application. Fig. 12 shows a section through a false oddside showing the drag rammed up.

Plate Molding

Much time can be saved in the making of molds if the pattern is divided in half across the parting and mounted in halves on two plates with parallel sides of the same shape as the parting.

The use of plates enables the molder to handle the patterns rapidly and with certainty, for he is relieved of the

task of making the joint between the two parts of the mold, the plate providing its own joint when the flask is rammed up. In addition, the patterns can be drawn quickly, as the plate overlaps the side of the box, and the pins which hold it in position act as guides during the drawing operation. Provided the patterns are satisfactory, practically no mending up of the mold is necessary.

Pattern plates are generally made of wood or metal, and the patterns may be mounted in halves either on both sides of a single plate or on one side of two plates. Fig. 13 shows a plate with half a pattern on each side in plan and section.

The sequence of operations entailed in making a mold from such a plate are as follow: The plate is placed on the cope and the drag on top of the plate. Facing-sand is sieved in and rammed up, and backing-sand added to fill the box, and the sand strickled off. The flask is next turned over and the cope rammed up in the same manner. The cope is then lifted off and the pattern or patterns on the plate drawn by lifting the plate off the drag.

Provision of Gates

Where a number of patterns are mounted on one plate, the gates—i.e. the channels from the runner to the molds—are allowed for on the pattern plate and made as part of the mold. These are shown in Fig. 13. Runners and risers are now cut, and runner cup added. The mold is then finished and ready to be closed, weighted, and cast.

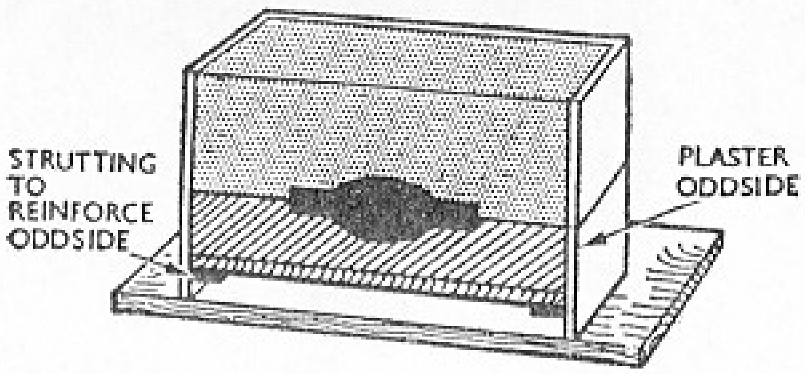


Fig. 12. Section through plaster oddside, showing the drag rammed up. The use of a false oddside saves considerable time, as it obviates the necessity of making a new oddside for each mold. When making the oddside the plaster need not fill the box, but need only be sufficiently thick to withstand ramming.

Metal patterns are frequently used in plate-molding where large numbers of molds are required from one plate. They are highly burnished to facilitate drawing.

Single-sided pattern-plates are used chiefly in conjunction with molding-machines. The halves of the pattern must be very carefully positioned so that when the two halves of the flask come together the two halves of the mold register exactly.

Use of Snap-Flasks

Snap-flasks are flasks which are hinged at one corner so that they can be opened and the mold removed. Molds are made in these flasks, but not cast in them, and their use in foundries engaged in repetitive work effects a great saving in flasks, which are very expensive. Molds are made in snap-flasks in precisely the same way as in ordinary ones. Fig. 14 shows a typical snap-flask with a locking device A. It is hinged at B, and the two parts are held in register by the pins C. These are triangular in section and fit into a movable slide D. The grooves E are

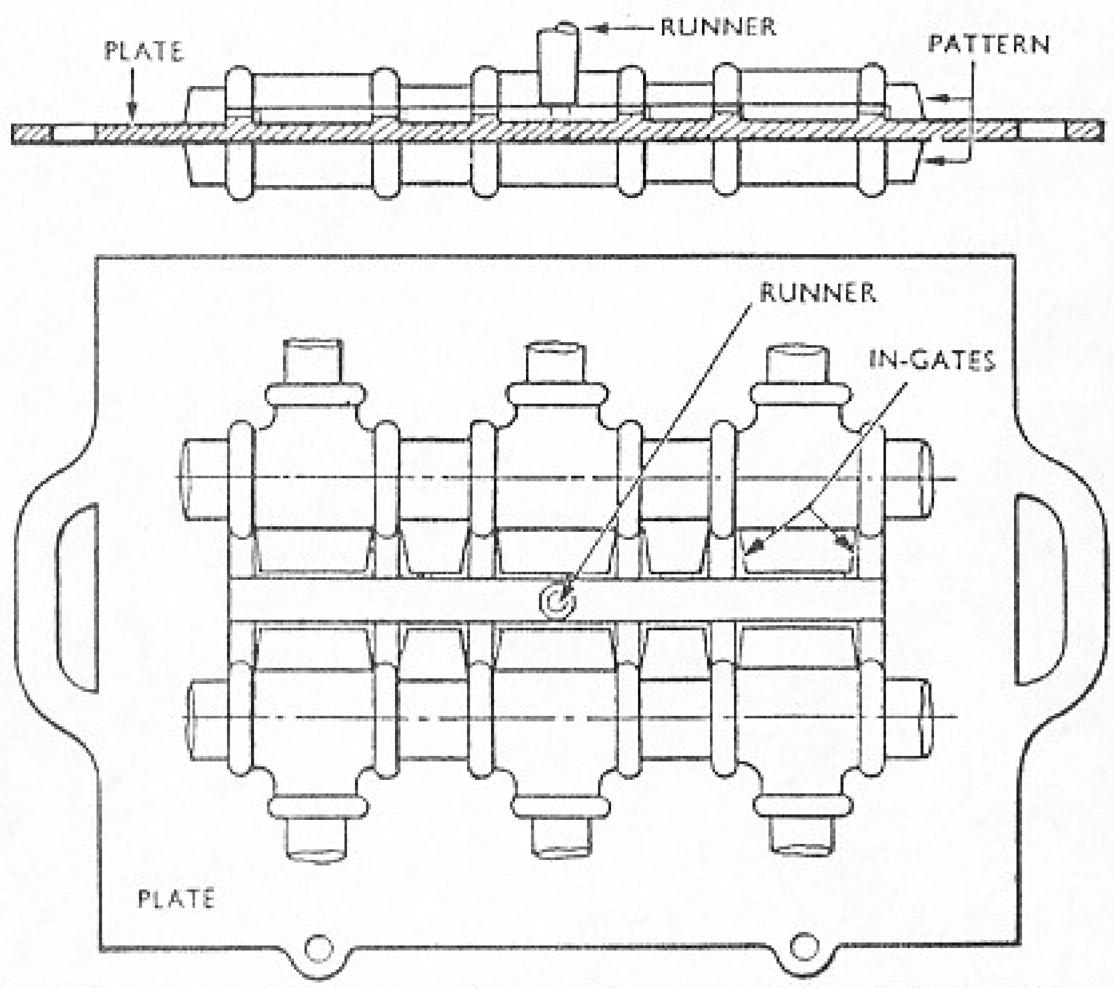


Fig. 13. Plan and sectional views of a double-pattern plate on which several patterns are mounted. The gates into each mold are allowed for in the pattern.

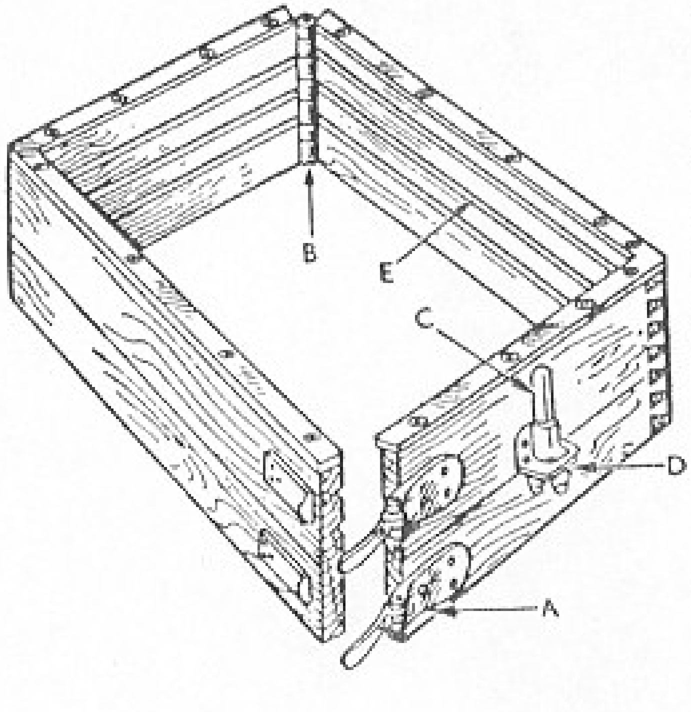


Fig. 14. By using a snap-flask such as that shown, left, considerable saving in flasks may be effected. When the mold is completed the flask is opened and the mold removed. The main parts shown are: A, locking device; B, hinges; C, pins to hold parts in register; D, slide to take pins; E, grooves to retain sand in flask.

provided for the retention of the sand in the flask. Snap-flasks are largely used in connection with the molding of patterns from plates.

Machine Molding

In recent years the use of molding-machines has become the accepted means of producing castings in very large quantities. The molding-machine performs two important functions—it rams the mold and draws the pattern, no specialized knowledge or skill being required on the part of the operator. There are many types of machine in use—manually operated, hydraulic, pneumatic and electric.

These again can be sub-divided into two main types: straight-draw and turn-over.

The straight-draw machine lifts the mold away from the pattern, whereas the turn-over, as its name implies, turns the mold over before drawing and draws the pattern away from the mold. The former is used where there is no weight of sand in the form of cods adhering to the face of the mold.

The turn-over machine is used where heavy sand projections make it impossible for the mold to be drawn upward from the pattern. A mold with such a projection can be seen on the table of the machine illustrated in Fig. 20 D. We will now deal with these types of machine in turn.

Hand-Operated Machines

Hand machines are usually of simple design and area, as a rule, only employed in the manufacture of the smaller types of castings. In some cases they consist only of a table with an attachment for drawing the pattern, the mold being rammed by hand as with floor work. On other machines the ramming is done by a squeezing device, the pressure being obtained by mechanical leverage of some form or other. An example of a hand-squeeze straight-down machine is illustrated in Fig. 15.

Straight-Draw Machine

The patern is fixed to the table, A, and the flask is placed over the pattern and filled with sand. It is then roughly rammed round the edges of the flask, usually with the handle of a shovel. The squeeze head, B, is then swung over the mold in the position shown in Fig. 15, and the lever, C, is pulled forward, applying the pressure through a crank to the ram, D. This causes the squeeze head, B, to descend and pack the sand in the flask. The arm is then lifted by returning the lever, and the head swung clear of the machine. The handle, E, is then moved from left to right, and through a crank raises the four pins, F. These are so adjusted as to register with the four corners of the box, and thus, when the pins are raised, the box is lifted from the pattern. During the drawing process it is customary to rap the pattern plate with a mallet to assist the draw. The weight of the box on the four pins is counterbalanced by the weight, G, enabling a very steady pattern draw to be obtained.

The mold is then lifted from the pins and the latter returned to their original position by moving the lever, E, from right to left. This completes the cycle of operations, and the machine is ready to receive the next flask.

Use of Two Machines

It is often the practice to employ two machines in the production of a single mold, half being made on one machine and half on the other. It follows, therefore, that considerable care must be taken by the pattern maker in mounting the patterns accurately, so that when the molding-boxes are mated the two halves of the mold will register exactly. A turn-over machine will very often work in conjunction with a straight-draw if one half of the mold has a cod that is difficult to draw and the other has not.

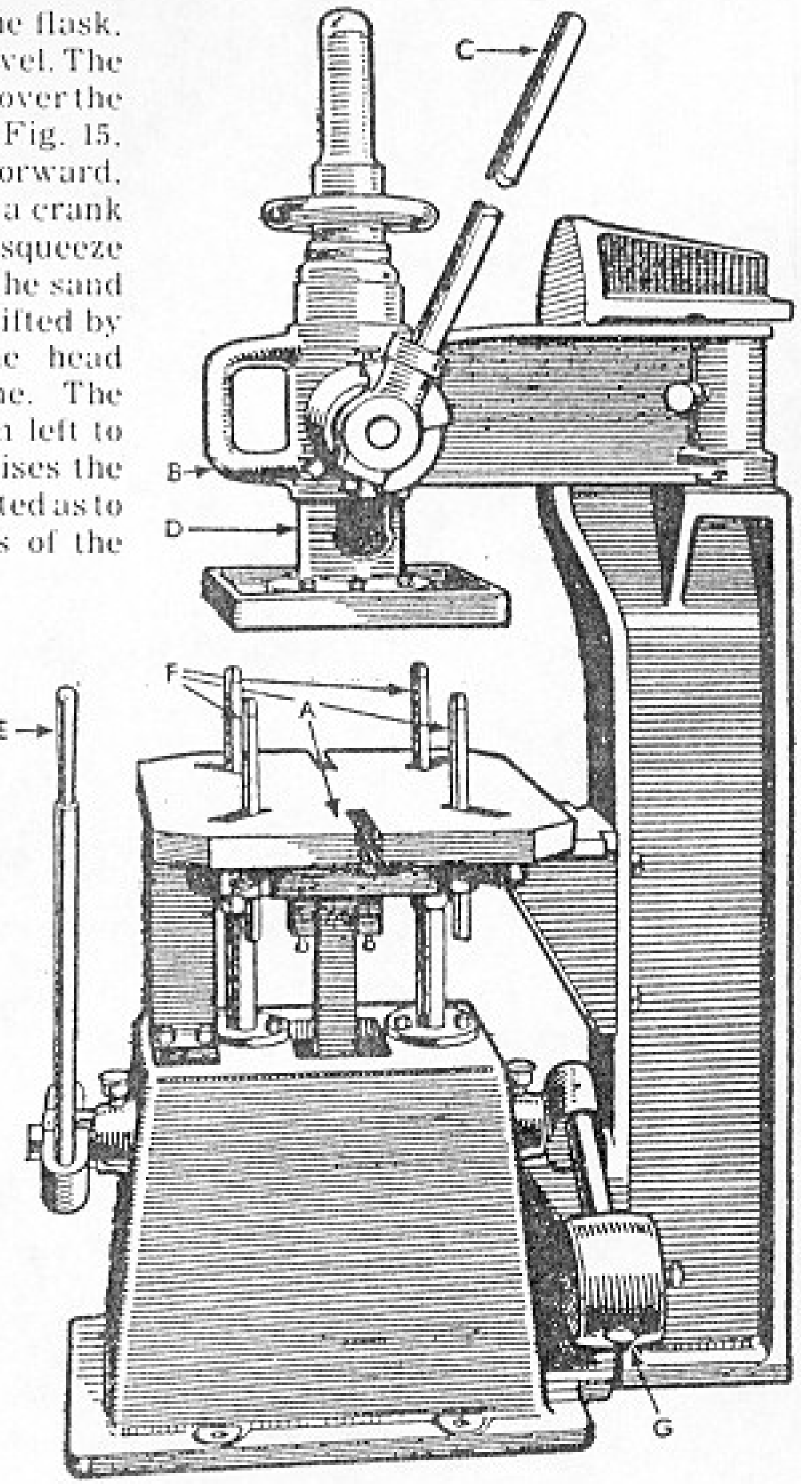


Fig. 15. Hand-operated straight-draw molding machine. The pattern is fixed to the table *A* and the flask placed over it and filled with sand. It is then roughly rammed round the edges of the box. The squeeze head *B* is then swung over into the position shown above, and the lever *C* pulled forward. This operates the squeeze through the ram *D*, and squeezes the mold. The pattern is drawn by the four pins *F*, which rise when the handle *E* is moved from left to right. The weight of the box on the pins is counterbalanced by the weight *G*.

Assuming that each operator works at approximately the same speed, the molds may be closed as soon as they have been removed from the machine, had the runners cut, and any cores inserted. It is often the practice, particularly where there are a large number of cores to set, to employ a third man to do the coring and closing up of the molds.

Hand Turn-Over Machines

The pattern on this type of machine is fixed to the main table, A (Fig. 16). The method of ramming and squeezing is precisely the

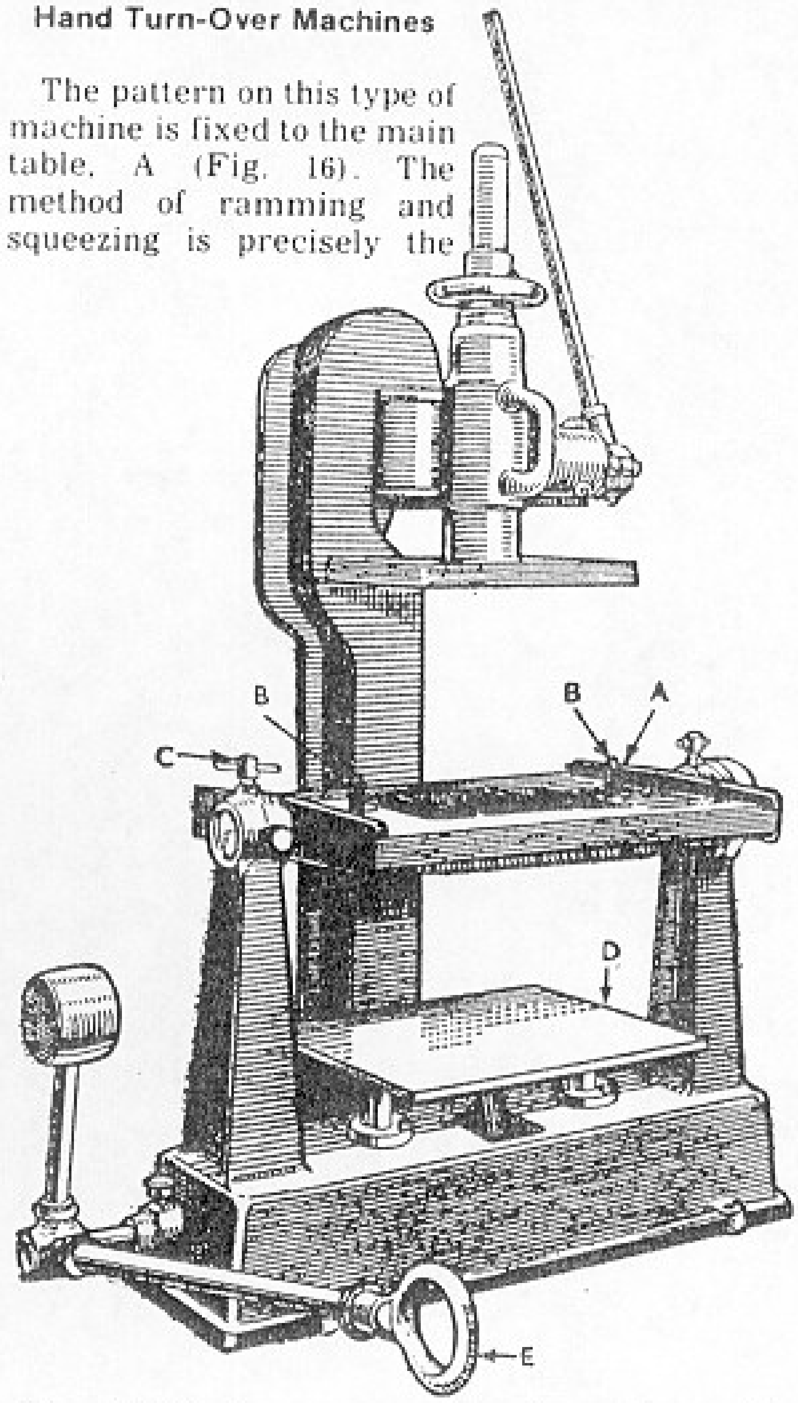


Fig. 16. The turn-over machine, shown above, differs from the straight-draw in that it draws the mold away from the pattern in a downward direction. It is used mainly where the mold contains large sand projections, or cods. The pattern is fixed to the main table *A* and the box placed over it. The method of ramming and squeezing is exactly the same as with the straight-draw machine (Fig. 15). After squeezing, the flask is clamped to the table by means of the pins *B*, and the table turned over through 180 deg. and locked in position by the screw C. The draw-table *D* is raised by the lever *E* to support the underside of the flask when the clamps are released and the draw-table lowered away.

same as with the straight-draw machine just described. After squeezing, the flask is clamped to the table by means of the pins, B, and the table turned through 180 deg. The table is locked in position after being turned over by the screw, C.

The draw-table, D, is next raised by lifting the lever E until it supports the underside of the flask, when the clamps B are releaed and the mold drawn away from the pattern in a downward direction by lowering the lever, E. During this operation the pattern plate is rapped with a mallet as before. The mold is lifted from the draw-table and the main table turned back again to its normal position ready for the next job.

Power-Operated Machines

The next machines to be dealt with are those operated by power, the simplest form of which is the squeeze-machine. These differ from the hand-machines only in that the squeezing operation and the pattern draw are worked by power, hydraulic, pneumatic, and electrically driven machines being the most usual.

A popular type of power-machine is the pneumatic, or compressed-air type. Its popularity arises from the fact that it covers a very much wider range of molds than the others, and in addition can successfully handle many types of mold that cannot be made on the other machines.

Advantages of Air-Machines

The main advantage the air-machine possesses over its competitors is the fact that it does not rely for ramming on direct squeezing pressure only but has a shaking device, usually termed the *jolt* which enables any depth of sand to be rammed, whereas with plain squeeze-machines there is a definite limit to the depth of sand that can be rammed. Furthermore, a very much more uniform ramming density is obtained when a jolt is employed, resulting in considerable improvement in the quality of the castings.

Pneumatic Straight-Draw

Both straight-draw and turn-over machines may be power-operated, and we will first of all describe a pneumatic straight-draw machine as illustrated in Fig. 17. This machine has a table, A, to which the pattern-plate is fixed. The flask is placed over the pattern in the usual manner, and the lever, B, moved to the jolt position. This causes the table to rise and fall rapidly and has the effect of ramming the sand in the flask. While the table is in motion the sand is shoveled into the flask, and when it is full the arm, C, is swung into position above the flask and the lever, D, depressed. This operates the squeeze-piston, which lifts the table and squeezes the mold against the presser-plate, E. The squeeze-lever, D, is then returned to its original position and the arm, C, swung clear of the table. The lever, B, is now moved to the draw position, which causes the four pins, F, to rise and lift the mold from the pattern in exactly the same way as in the case of the manual type.

During the first part of the draw the pins rise slowly, and gradually increase in speed as the mold gets clear of the pattern. While the drawing operation is in progress the table is automatically shaken by a vibrator beneath it. This replaces the rapping of the pattern-plate in the manual machines and insures an easy and clean drawing action. The mold is removed from the pins and the draw-lever returned to neutral. That completes the cycle of operations.

How the Air-Machine Works

A very brief description of the internal construction of this machine will give the reader a clearer understanding of its method of working.

Fig. 18 is a sectional drawing of the body of the machine illustrated in Fig. 17. The main cylinder is cast with the frame, A. This is accurately machined and ground to take the squeeze-piston, B. This piston is bored out in the center with a similar cylinder in which moves another piston, C. The piston, C, is fixed to the

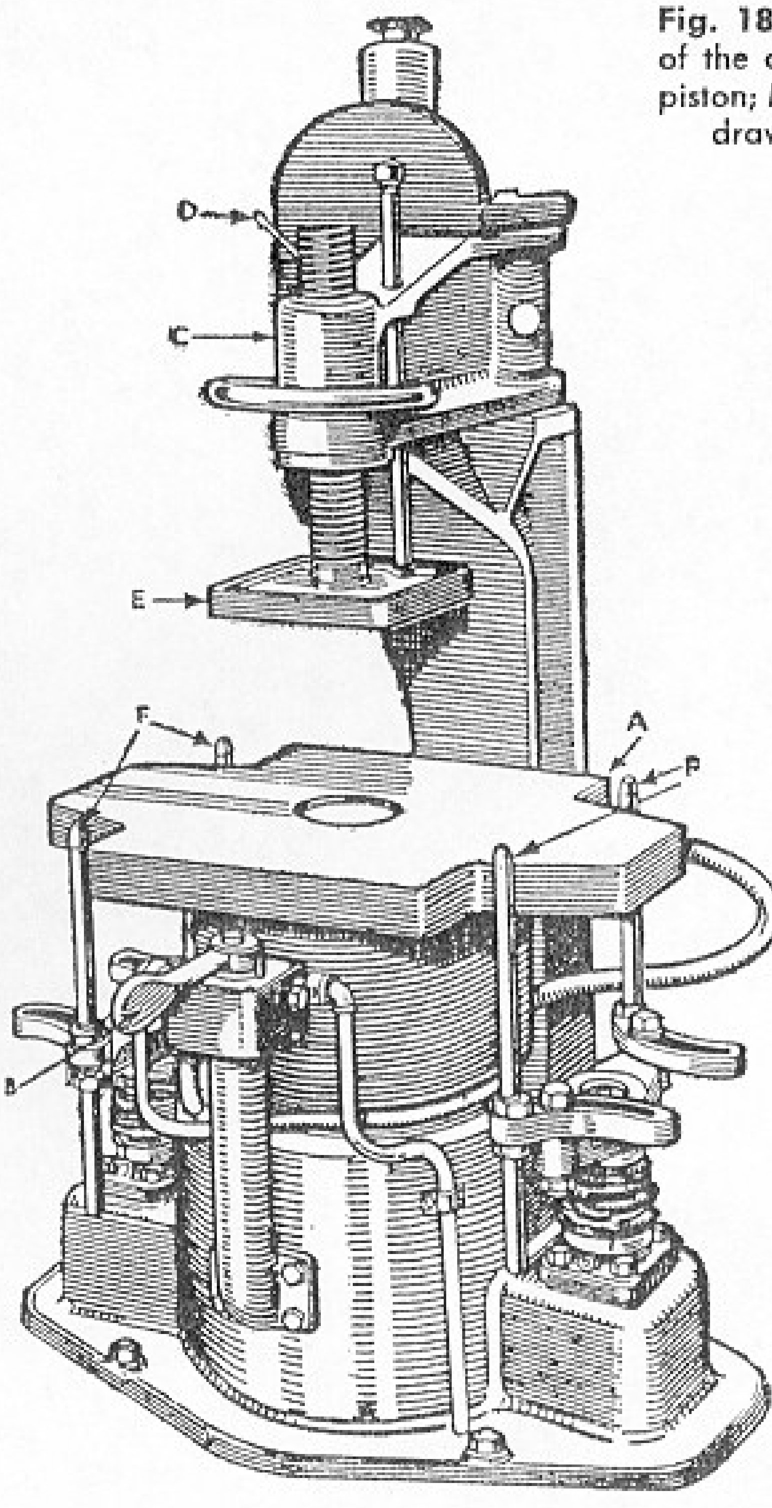
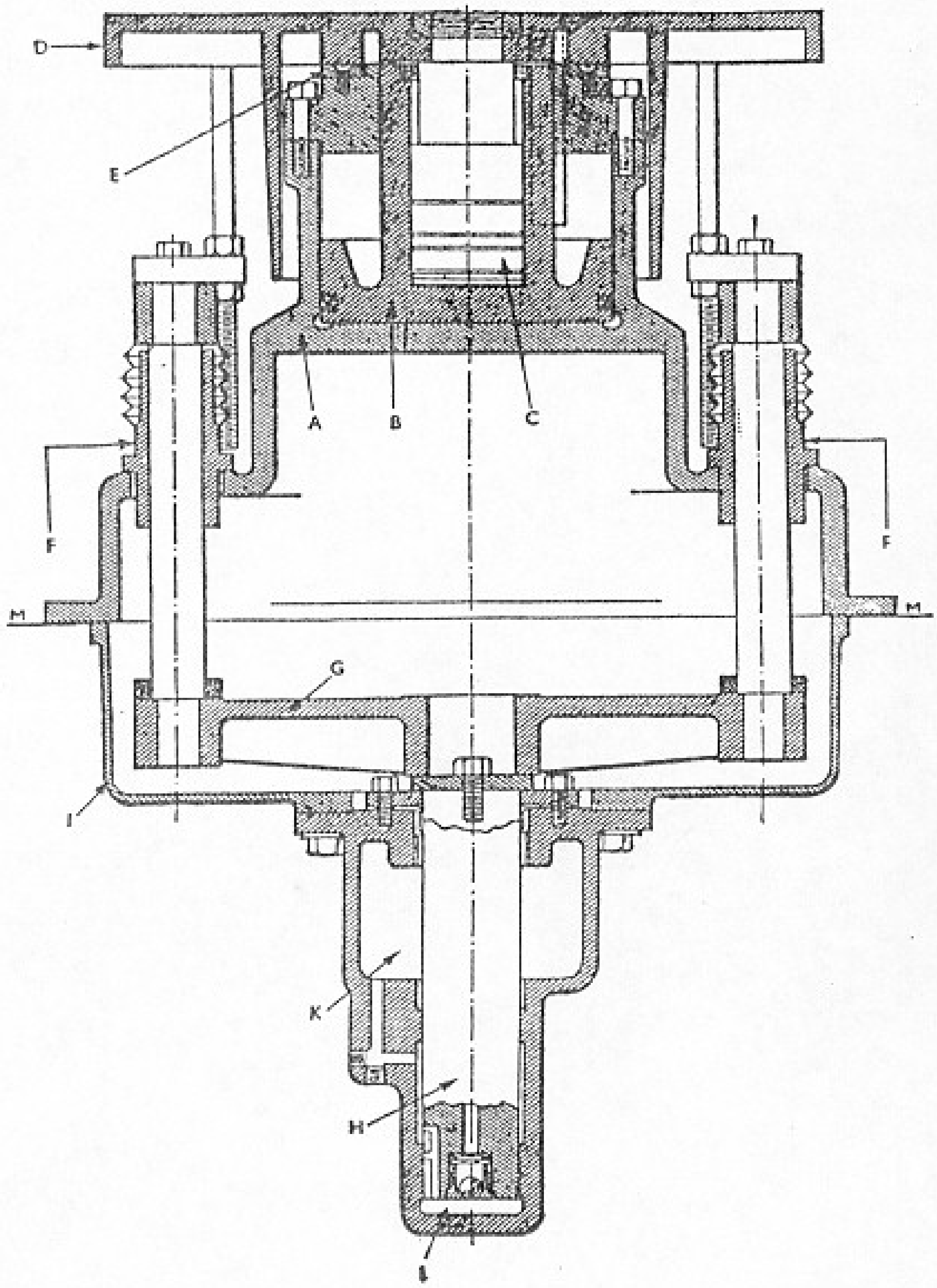


Fig. 17. Pneumatic straight-draw molding machine. Besides performing the squeezing and pattern-drawing automatically, this machine possesses two features not included in the hand-operated type. These are the jolting device, for ramming the sand, and the vibrator, which assists in drawing the pattern cleanly. The main features are shown above: *A*, the pattern table; *B*, lever for operating the jolt; *C*, squeeze-head arm; *D*, lever for operating squeeze; *E*, presser-plate; *F*, pins for lifting box.

Fig. 18. Sectional drawing of pneumatic straight-draw machine, showing details of the operations. *A*, frame containing main cylinder; *B*, squeeze piston; *C*, table piston; *D*, table; *E*, jolt anvil; *F*, draw-rod guides; *G*, bridge coupling draw-rods; *H*, draw-piston; *J*, casing; *K*, oil reservoir; *L*, draw cylinder; *M*, ground level.



table, D, which in its normal position, rests on the anvil, E.

The Jolt-Cylinder

When air is admitted into the jolt-cylinder, the jolt-piston rises about 1½ in., in which position it uncovers an exhaust port which allows both piston and table to fall, the table hitting the anvil, E, with a sharp blow. This up-and-down movement of the table continues throughout the jolting process at approximately three hundred strokes a minute.

When the squeeze pressure is applied to the main piston, B, the table and jolt-piston are lifted upward and the flask on the table pressed against the squeeze-plate, the table-pressure on the small machine illustrated amounting to about three tons.

The draw-rods that lift the mold from the pattern operate through two guides, F, which are attached to and coupled together through a bridge, G. This is in turn fixed to a solid piston, H, the whole being housed in the casing, J.

The reservoir, K, is filled with oil, and when the pattern draw-valve is moved, air pressure is applied to this reservoir, forcing the air down the channels situated immediately below and allowing it to enter the chamber, L. This causes the piston to rise, thus effecting the draw.

The pneumatic turn-over machine is illustrated in Fig. 19. The method of

operation is similar to that described for the straight-draw machine in so far as the jolting and squeezing of the mold are concerned. After the squeeze pressure has been applied, the lever, A, is moved, which causes the machine to rotate through 180 deg. about the shaft which is coupled to the column at B.

The machine is then in the position illustrated in Fig. 20. The lever, B, is depressed, causing the table and the pattern, C, to rise and leave the mold, D, on the squeeze-plate, E. The mold is then taken off the machine.

The lever, A, is then moved back to the neutral position, causing the machine to turn back.

The construction of the machine so far as the jolt and squeeze are concerned is identical with that of the straight-draw illustrated in Figs. 17 and 18.

Turn-Over Mechanism

The turn-over mechanism consists of a shaft running through the main housing, C (Fig. 19). This shaft is coupled to the column at B. A sprocket-wheel is keyed to the shaft under the cover, D, over which passes a chain connected to two pistons situated in the lower part of the housing. The turn-over valve merely allows the air to pass from one cylinder into the other, thus rotating the sprocket and causing the machine to revolve.

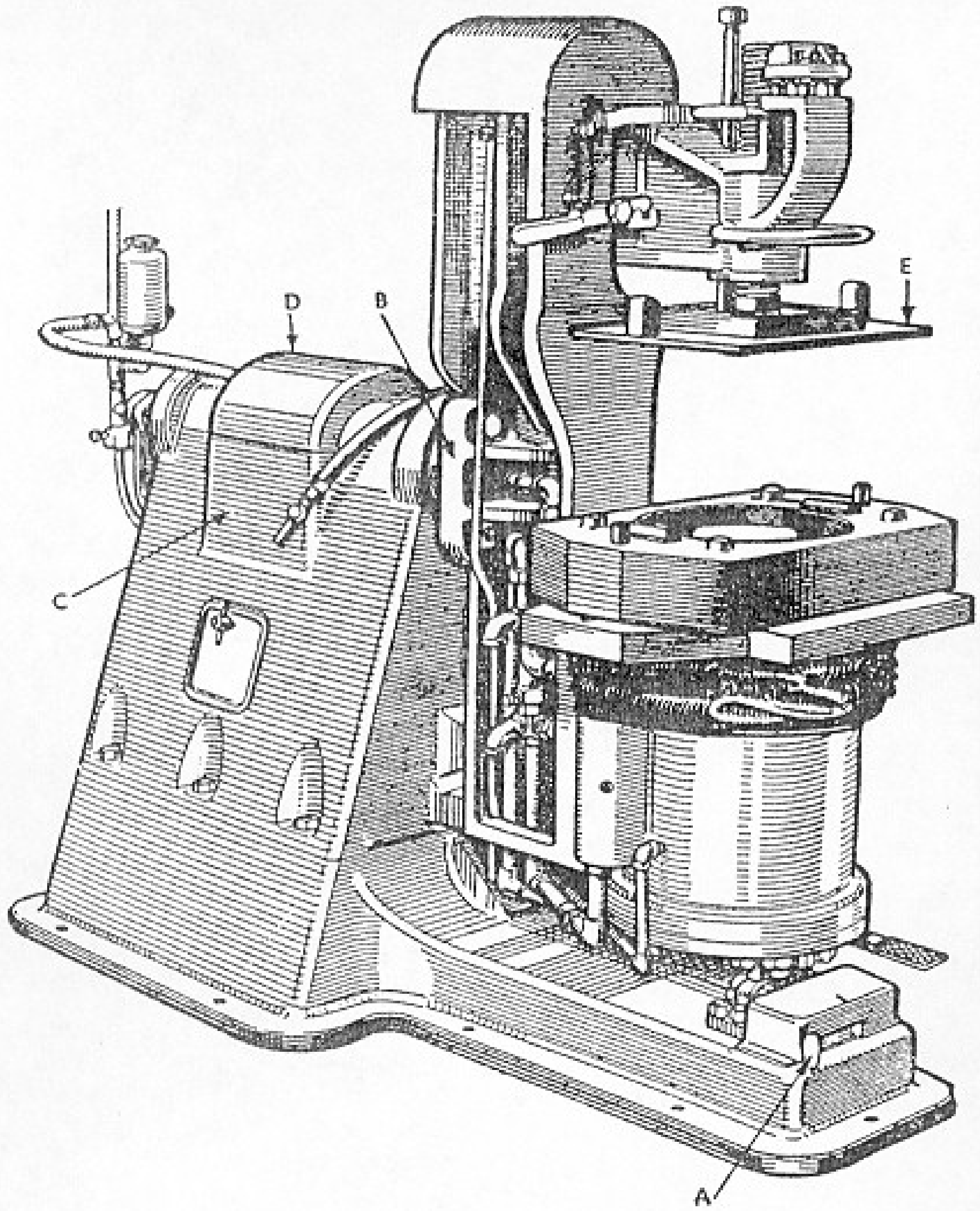


Fig. 19. Pneumatic turn-over molding machine, showing pattern fixed on table. The method of operation is similar to the straight-draw, but the machine is turned over before the pattern is drawn. *A*, lever operating turn-over; *B*, shaft on which machine rotates; *C*, main housing; *D*, housing cover; *E*, squeeze-plate.

Hoppers and Conveyors

Molding machines, and particularly those of the power-operated type, turn out molds at a considerable speed, and it is frequently the practice in large foundries to employ hoppers to keep the machines supplied with sand. These hoppers are placed over the table and filled by means of conveyors at a speed proportionate to the speed of the machine. In such foundries other conveyors are usually used to carry away the finished molds from the machine to be cast. It need scarcely be added that in such cases continuous pouring is always employed.

Machines for Multiple Molds

The use of molding machines in small foundries frequently causes difficulties through lack of sufficient floor space, for even if the molding machines themselves do not occupy a great deal of room, considerable space is necessary for the finished molds and the many empty flasks.

This problem, which arises through the speed with which the machines turn out the molds, is sometimes solved by multiple molding. Machines are used which are capable of making two half molds in a single half-flask. The flasks are stacked one on top of the other, a complete mold being formed at each joint; and the whole stack is poured through a single runner, gates being provided for each mold. All the runners are made wider at the top than the bottom, so that when pouring begins the metal will fill the bottom box first, the boxes above being filled in turn as the metal rises. Reference to Fig. 21 will make this point clear.

Machines used for multiple molds sometimes consist of a pattern plate, with one half of the pattern on it, and a squeeze head which carries the other half of the pattern. The half-flask is placed on the pattern plate, a sand-frame placed on it, and filled with sand. The presser head is then brought over the half-flask and the mold squeezed in the usual manner. A half-mold is thus made on both sides of the half-flask at one operation. Only comparatively small castings are made in this way, for it is doubtful whether the quantity of sand required to fill a large half-flask could be satisfactorily

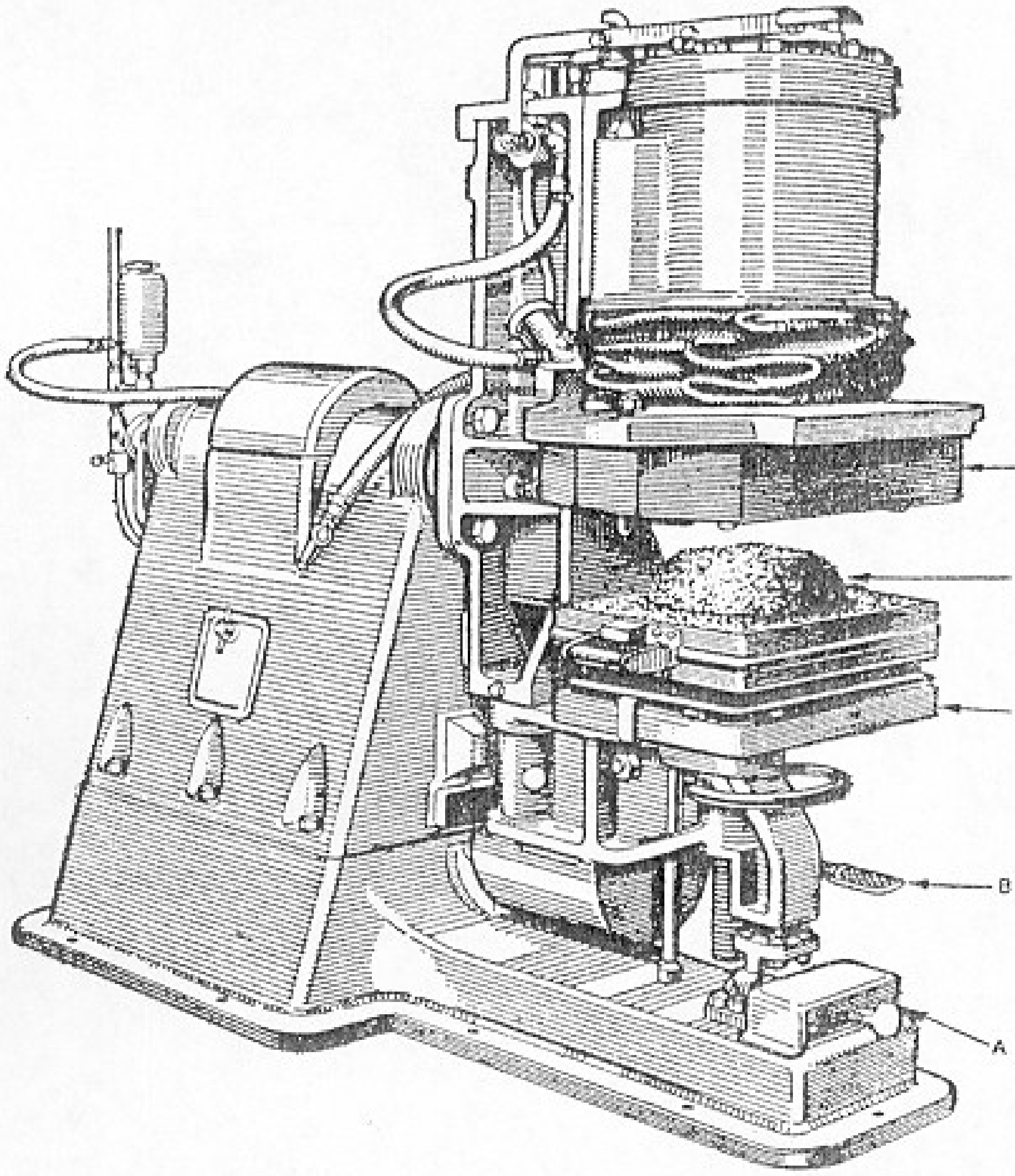


Fig. 20. Pneumatic machine in turned-over position, showing the mold after the pattern has been drawn. A, turn-over lever; B, draw-lever; C, pattern; D, mold; E, squeeze-plate. The mold shown affords a good illustration of the use of the turn-over machine, for it would be difficult to draw the projection, or cod, upward from the pattern without it becoming separated from the parent mold.

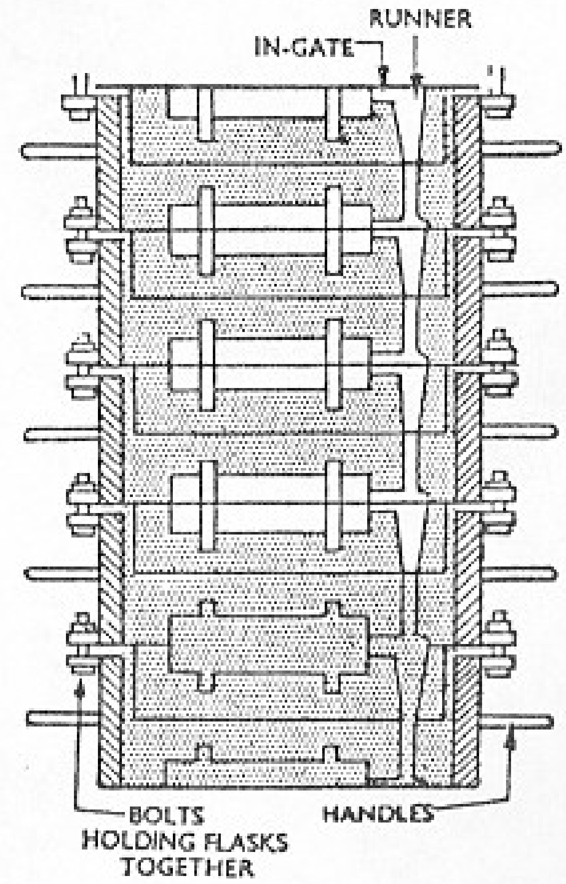


Fig. 21. Special machines are sometimes employed which mold two halves of a mold, half on each side of a half box. The boxes are then stacked on each other, a complete mold being formed at each joint, and the stack is poured through a single runner. The diagram illustrates the principle of this system.

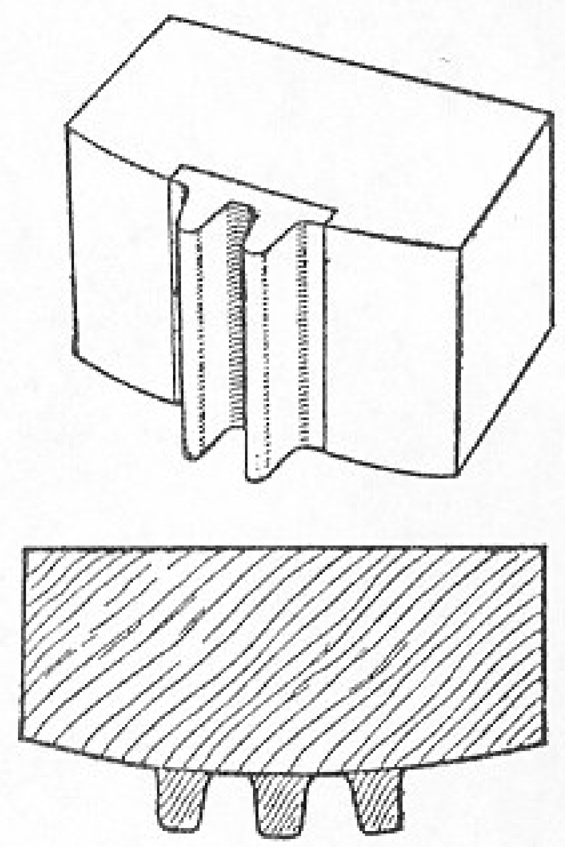


Fig. 22. Tooth-blocks used for molding gears. They consist of a short segment of the periphery of the gear to be molded.

rammed to stand any real weight of metal.

Machine-Molded Gears

Machines are largely employed for molding all kinds of spur, worm, bevel, miter, and helical gears, complete patterns for which would cost a considerable sum. The patterns in use on such machines consist only of a single tooth-space or short segment of the periphery known as the tooth-block (see Fig. 22). This block is attached to a bracket on the machine as shown in Fig. 23. By repeating the mold of the tooth-block the required number of times molds may be made for gears of any diameter. Core-boxes are employed for molding the arms.

Details of the Machine

The mold is made in a circular molding-box which is carried on the revolving table of the machine as shown at A, Fig. 23. The table is revolved by means of the handle, B, which, through a bevel gear, C, turns one of the two parallel horizontal shafts under the table. At the other end of this shaft is a change-gear, E, on the other shaft. The latter carries the worm, F, in the center, which actuates the dividing-gear, G, attached to the under-side of the table.

By this means the table can be turned through any required fraction of the circumference of a circle with great accuracy, thereby repeating the mold of the tooth-block. It stands to reason that for each tooth the table must turn through an angle of $\frac{360}{x}$, where x = the number of teeth in the wheel. The method of regulation is by means of change-gears, and is similar to the method adopted in a thread-cutting lathe and explained in Chapter 4.

The tooth-block, H, is attached to the lower end of the carrier, I, which

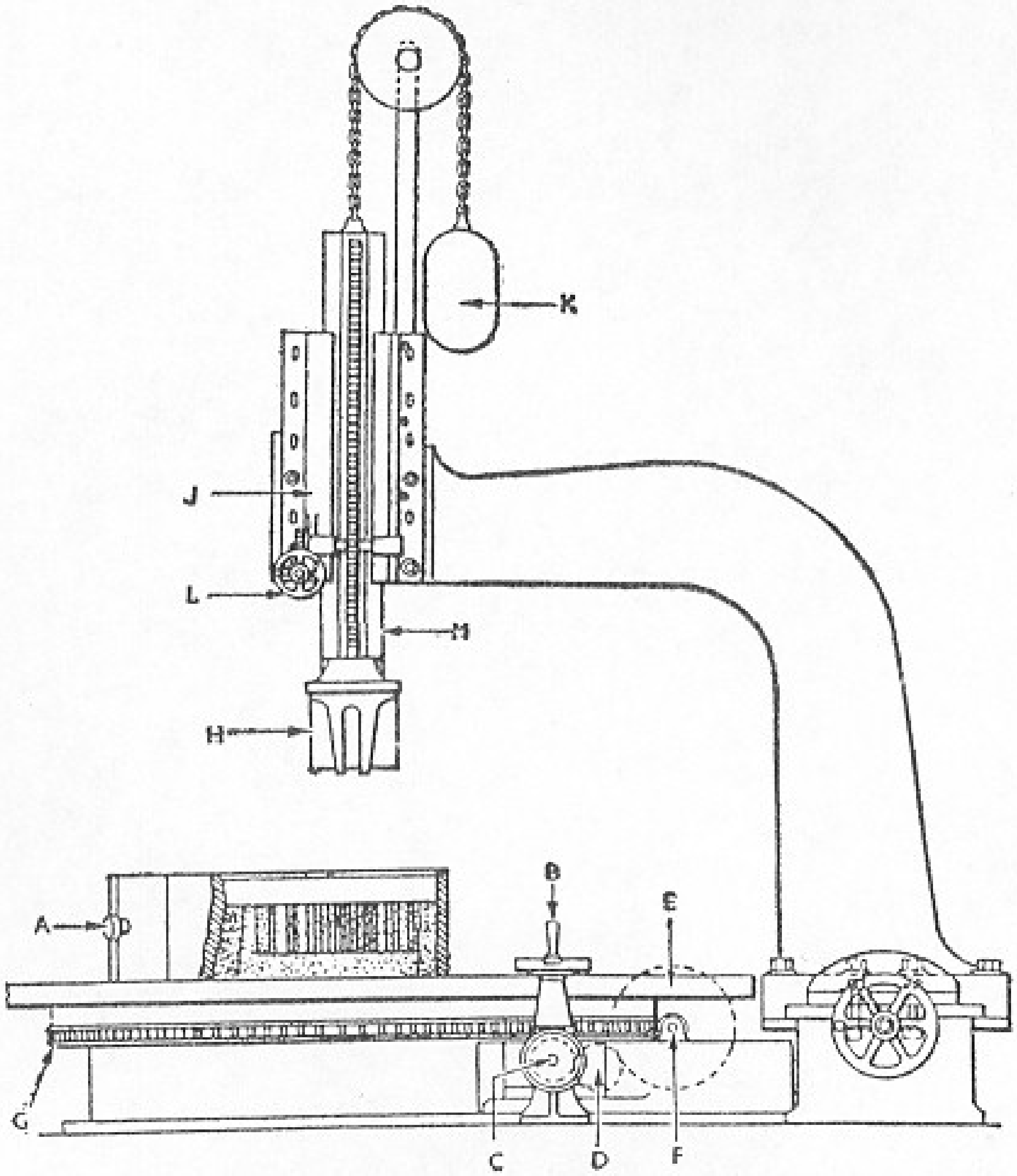


Fig. 23. Main features of a gear-molding machine. *A*, revolving table; *B*, handle for revolving table; *C*, bevel gear; *D* and *E*, change-gears; *F*, worm; *G*, dividing-gear; *H*, tooth-block; *I*, carrier; *J*, guides; *K*, weight; *L*, turning-handle.

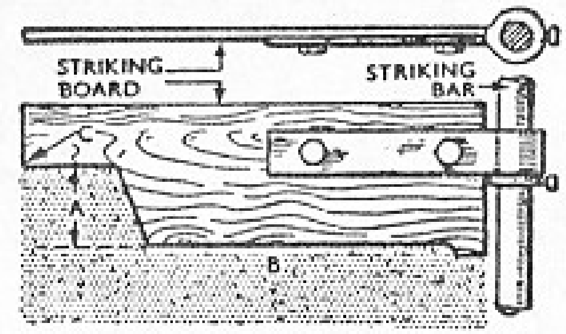


Fig. 24. Striking-board used to prepare the bed for molding gears. *A*, depth of face of gear; *B*, bottom edge of board that strikes the bed; *C*, top edge of board that strikes the mold-joint.

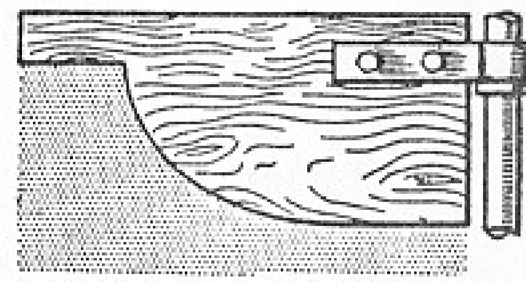


Fig. 25. Striking-board used for striking a cope direct.

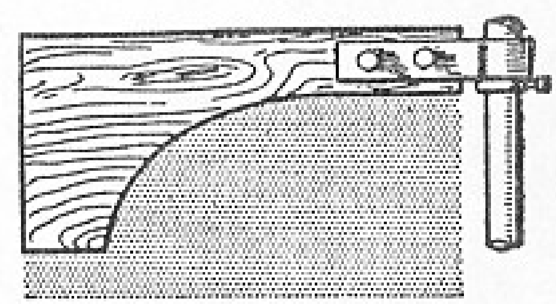


Fig. 26. When a cope is rammed up in a reverse mold a sand-bed is made and struck to the required shape by means of a suitable striking-board such as that shown above.

slides in the guides, J, and is counterbalanced by the weight, K. By turning the handle, L, the carrier may be racked up and down to any desired height.

The gear is molded by placing the box on the machine-table and preparing a bed with a striking-board which fits on to a central spindle in the table. This is shown in Fig. 24, A being equal in depth to the depth of the face of the gear. The bottom edge, B, strikes the bed, and the top edge, C, the joint of the mold. The spindle and striking-board are then removed, and the tooth-block, having been screwed to the carrier, is set to the correct radius and lowered until its face bears on the sand-bed.

Facing-sand is next rammed between the teeth of the block, and if the wall of the bed is sloping, as would be the case if it were made with the striking-board in Fig. 24, the slope is also filled up. The ramming should be done with a small wooden pegging rammer to avoid damaging the pattern. A flat rammer is used for the top, and the joint scraped and sleeked with a trowel. The teeth are vented and the pattern is lifted clear of the mold. Gentle rapping during lifting will help the pattern to come away cleanly. The table is then revolved through one space, lowered into position, and the operation repeated until the circle is complete.

As the tooth-block molds a ring of teeth only, the interiors of the gears have to be formed with cores. These are made in core-boxes and put into the mold before it is closed.

Making the Cope

Copes for flat gears may be rammed up on a flat surface, but copes for bevel gears or gears that are not flat may be made by means of a striking-board or rammed up in a reverse mold. Copes made by the latter method are generally more satisfactory, as they can be rammed up harder than by a striking board.

When the copes are struck direct, a striking-board is used which produces a surface similar to the top of the mold the cope has to fit. This board must be so adjusted that its upper surface is in the plane of the joint between the two parts of the mold. Fig. 25 shows a striking-board for striking a cope direct.

For ramming a cope up in a reverse mold a hard sand-bed is first made and the surface struck up to shape with a reverse board, as shown in Fig. 26. The cope is now put on, parting-powder added, and rammed up as if on a pattern.

Machines for molding gears may be either bench types, as shown in Fig. 23, or floor machines. The latter are used for molding gears up to 25 ft.

Mending-Up of Molds

Few sand-molds, with the possible exception of those made on molding-machines from plates or from very good patterns, are perfect when the pattern has been withdrawn. Faults of various kinds are liable to arise, the most common being caused through rough patterns, patterns made without sufficient taper, or through bad workmanship; and the result is that when the pattern is withdrawn from the mold, parts of the mold become fractured or broken off. Bad ramming is a frequent cause of bad molds, or rapping too vigorously while withdrawing the pattern may break down weak parts of the mold or weaken them to such an extent that they wash off when the metal is poured. Jerking of the pattern while drawing it may also cause portions of the mold to be broken or to become loosened.

Cutting Out Soft Spots

All parts broken or loosened through these or any other causes must be made good, and in addition any parts of the mold that are found on examination to be either too hard or too soft must be cut out and remade. If the mold is seriously damaged it is often quicker in the long run to remake it completely.

If the damage is small it is generally better to patch it by hand rather than with a trowel, for the latter tends to sleek the mold and close the pores, thereby impairing the venting. When applying new sand to the mold, as little water as possible must be used in assisting the sand to adhere to the parent mold, as this may chill the metal in that part of the mold and cause hard spots on the casting.

Use of Sprigs

In cases where the edges have suffered badly it is often a good plan to replace the pattern in the mold and make the repairs with the pattern in place. When this is done the sand should be well troweled to make it cohere. In this instance the use of the trowel is not injurious to the mold, as the metal does not come into contact with the sleeked surfaces.

Sprigs or small pins may be used to strengthen weak parts of the mold. These are small pins which are pushed into the sand below the surface and the holes filled in and made good. In some molds specially bent irons are used as strengtheners.

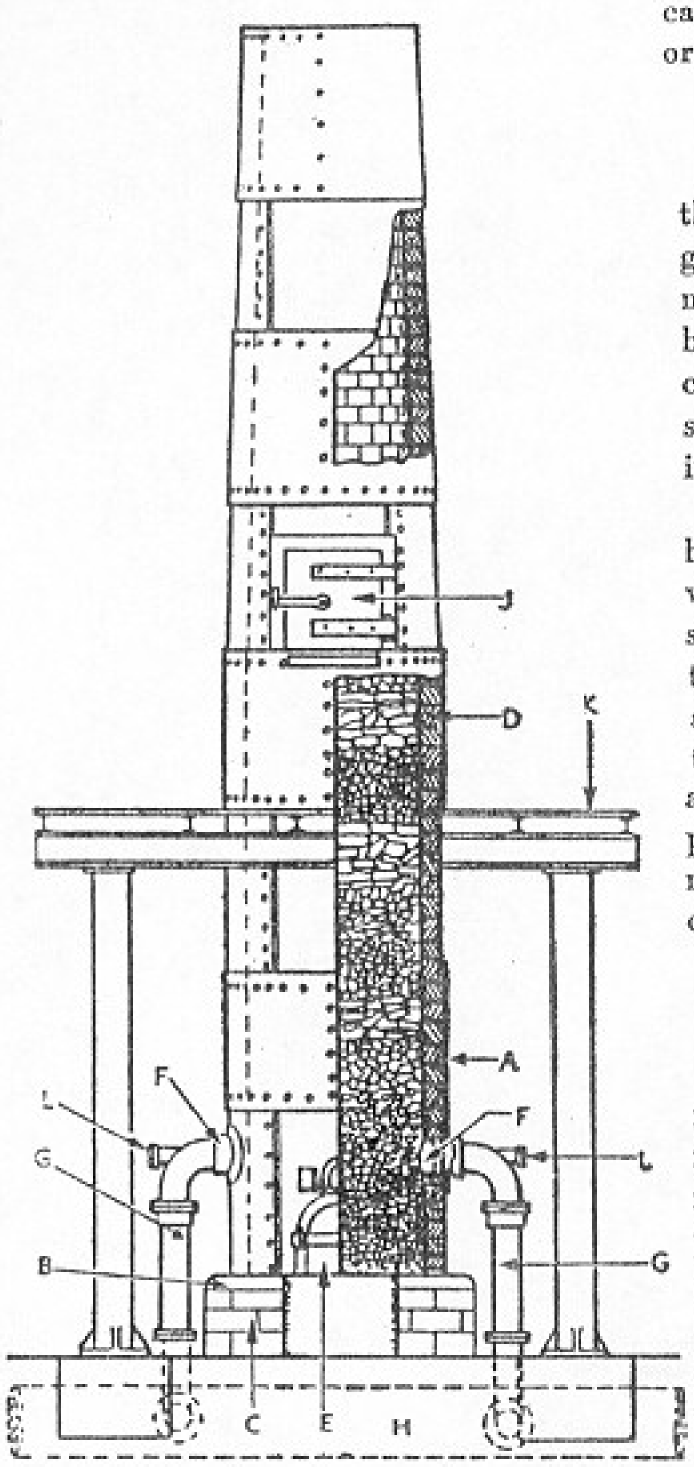


Fig. 27. Cupola, or furnace for melting iron. It consists of a shell *A* standing on a base-plate *B* supported by a brick platform C. The shell is lined with firebrick *D*. The fire is lighted through the opening *E* and the blast is led into the cupola through the tuyeres *F* and from the supply pipe *G*, which, in turn, connects with the main supply pipe *H*. The furnace is fed through the charging door *J* from the charging platform *K*. When the charging door is closed the swiveling heads of the tuyeres are swung into position and the blast turned on, the tap-hole being left open to allow the clay lining to dry. The metal, which begins to run after about 15 minutes of full blast, is observed through the mica sight-holes *L*.

Permanent Molds

For certain types of work, particularly in the manufacture of bedsteads, sand-molds are replaced by permanent ones made of metal, usually iron. The cost of such molds is obviously heavy, but where articles have to be produced in very large quantities, the time saved in making a fresh mold for each casting fully justifies the cost.

Non-chilling brands of iron are usually used in making castings in permanent molds, and the molds into which it is poured may be either cold or hot. It will generally be found that the best results are obtained if the molds are kept at a temperature of about 300 deg. F. The metal must be very hot when cast, and the castings must be turned out of the molds at approximately an orange-red color.

Soft iron cores are used in conjunction with permanent molds. These must be removed before the casting begins to contract, otherwise they will be gripped fast and it will be impossible to remove them.

Melting Iron

Iron for foundry purposes is melted in a furnace known as a cupola. This is a blast furnace, and a simple type is illustrated in Fig. 27. It consists of a boiler-plate shell, A, which rests on a base-plate, B, supported on a brick platform, C. The shell is lined with firebricks, D, and the iron base is covered with fireclay sloped slightly in the direction of the tap-hole in front of which a channel is fixed to carry the metal to the ladle. The cupola is generally built on the outside of the foundry wall, the channel from the tap-hole being carried through the wall into the molding shop.

On the side of the cupola shell opposite to the tap-hole is an opening

covered by a plate, E, through which the fire is lighted and the furnace cleaned out when necessary. The blast is led into the cupola by means of the tuyeres, F, each of which has a swiveling head resting on the supply pipes, G, which take the air from the main supply pipe, H.

The materials are fed to the furnace through the charging hole, J, placed at a suitable height above the charging platform. K.

Filling the Cupola

A fire is lighted in the bottom, and a charge of coke added. When this is well alight filling begins. A charge of iron of suitable weight is put in, together with a suitable flux. Another layer of coke is added and followed by a further charge of metal. The proportion of coke may vary between eight and twenty pounds of coke per hundred pounds of iron, according to the requirements of the cupola. Alternate charges of coke and iron are then added to fill the cupola.

Lining the Tap-Hole

This is done two or three hours before the blast is put on. During this period the various openings in the cupola are left open to assist combustion and allow it to become warmed throughout. Before the blast is turned on for melting down the metal, the tap-hole is lined with clay, and the plate, E, Fig. 27, packed round the edges with sand. The charging door, J, is then closed and the swiveling heads of the tuyeres swung into position. The blast is then turned on, but the tap-hole is left open at this stage to allow the clay lining to dry before the clay stopper, or bot, is put in. The stopping is done by sticking the bot on to the end of a bot-stick, and the latter held with the plug pointing downward toward the hole, in which position it should be driven home.

Full blast may now be turned on, and in about a quarter of an hour the metal begins to run down. This can be observed through the mica sight-holes, L, in the tuyeres.

When sufficient metal has collected, the bot is knocked out of the tap-hole with the sharp point of the bot-stick and the metal run down the channel into a ladle. As the metal in the cupola sinks, additional charges of metal, coke and flux are added as required.

Metal from the cupolas is collected in ladles and poured from these ladles into the mold. Ladles of various types are illustrated in Fig. 28. A is a hand ladle holding about half a hundredweight, used for very light casts; B is a two-man ladle for heavier work; C is a crane ladle for casting up to a ton of metal; and D a heavy crane ladle capable of holding from one to twelve tons. The ladle shown at C is tipped direct by means of the handle, while that at D is a geared type and is tipped by turning the wheel.

Ladles are lined with fireclay, and must be thoroughly heated before the metal is run into them. This is done in the case of small ladles by heating them over a coal or coke fire, but with the larger types a fire is lighted within them. When they have been filled the metal is protected with coal-dust or charcoal and covered with a plate.

All material used for covering the metal while collecting, or foreign matter thrown up by the metal, must be skimmed off before pouring begins, and in addition it is customary to hold a rectangular bar of iron across the mouth of the ladle during the actual pouring to keep back any dirt or other matter which remains floating on the surface of the metal and which, if it were allowed to enter the mold, would prove detrimental to the quality of the finished casting.

Temperature of the Metal

The temperature of the metal while being poured is of the greatest importance, as it influences the shrinkage of the casting during solidification. The lowest temperature at which the mold can be completely and properly filled is the best temperature at which to pour. This will, of course, vary with different types of mold, being influenced by the distance the metal has to run, the thickness of the mold, and other factors.

Pouring the Metal

Pouring must be done steadily, and a constant stream of metal must be maintained until the operation is complete. Any iron entering the mold in driblets is liable to become chilled and cause marks on the castings. In view of this, the runner-cup or pouring basin is closed by a stopper and metal poured in until the basin is full.

The stopper is then removed, and the flow of the metal from ladle to basin must be sufficiently rapid to keep the basin full until casting is complete.

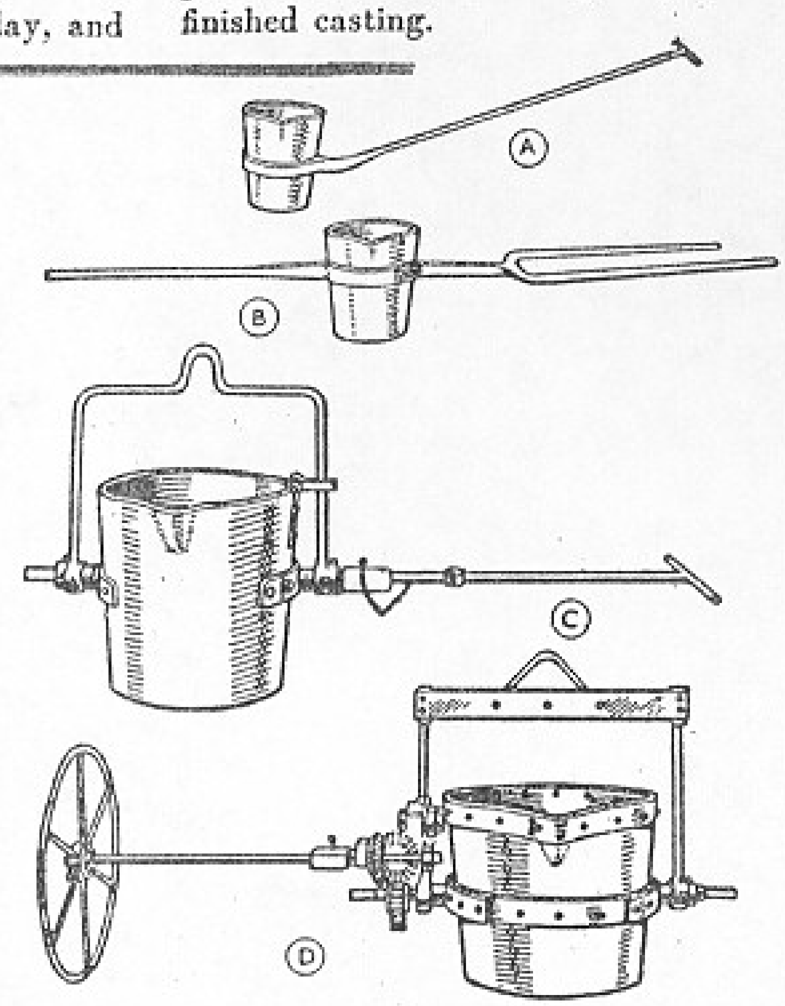


Fig. 28. Types of ladles used in the foundry. *A*, hand ladle for light casts; *B*, two-man ladle for heavier work; *C*, crane ladle for casting up to a ton of metal; *D*, heavy crane ladle with geared tipping device, capable of holding from one to twelve tons of metal.

A basin that is kept full in this way will also prevent foreign bodies from entering the mold, as these will float on the top of the metal.

When pouring very heavy molds a sand channel is sometimes made from the cupola to the mold and the metal poured without the use of ladles.

Feeding of Molds

Feed-gates are frequently provided in molds to compensate for the contraction of the metal as it cools and to supply fresh metal to make up the deficiency, thus stopping shrinkage of the casting. They are therefore cut in those parts of the mold where the mass of metal is greatest and the total contraction is large. If metal is not supplied in this way the castings may turn out to be spongy, or drawn and twisted, because of stresses set up during cooling.

Feed-gates are vertical passages cut through the cope to the mold. Like runners, they are provided with a cup or basin-shaped cavity at the top. Feeding is done by means of an iron rod ¼ in. or ⅜ in. in diameter, which is first heated by dipping it in the hot metal in the ladle. As soon as the mold is full, the rod is put into the molten metal in the head of the feed-gate and moved up and down in a regular manner, care being taken to avoid touching the sides of the gate or pushing it in so far as to touch the mold. The pumping movement of the feeder-rod keeps a passage open in the center of the metal and allows metal in the feeder-basin to pass down into the mold. Feeding is continued until the iron clings to the rod, which should then be removed with as little disturbance to the metal as possible.

In cases where the runner runs direct into the mold the latter may be fed through the runner, although this should only be done in cases where very clean metal is used. Fig. 29 shows a mold being fed as described.

When castings are cool enough to be removed from the sand the boxes are knocked and the castings allowed to cool down uniformly. The cooling process should not be hurried, and on no account should artificial cooling be resorted to.

Fettling

The castings are now ready to be cleaned up and finished. When they are removed from the mold they have several unwanted projections in the shape of runners, risers, feed-gates, etc. These are removed, in the case of iron, by nicking them with a chisel and snapping them off. Non-ferrous runners are sawed off, and steel ones removed by means of the oxy-acetylene cutting process. The core-holes should then be cleaned out and any fins removed with a cold chisel.

Cores are cleaned out by means of drifts or otherwise. The use of a wire brush on the exterior faces of a casting will remove any sands adhering to it, while sand-blasting is also employed for this purpose. Castings that are not too delicate may be cleaned by tumbling in a rattler, and even fragile castings, if properly filled, may be treated in this way.

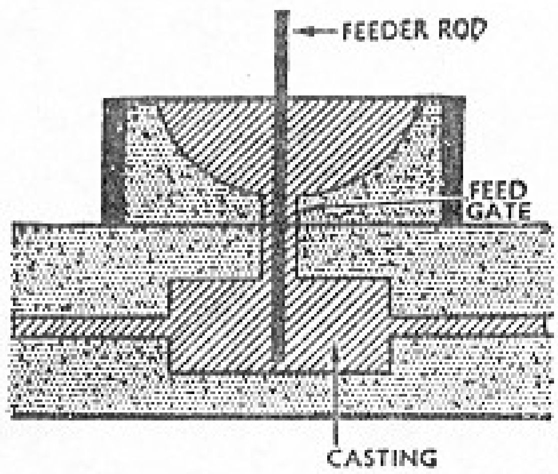


Fig. 29. Feeding a mold. The pumping action of the feeder-rod keeps a passage open in the center of the metal and allows the metal in the feeder-basin to pass down into the mold. Feeding compensates for the contraction of the metal as it cools.

Mixing Iron

Cast iron is readily recognizable by its brittleness and its inability to bend without breaking. When being machined, the chips are small, brittle crumbs, and parts of the casting may be so hard that they cannot be touched with a machine tool or a file. There are, however, various grades of cast iron, and these are produced by mixing different types of iron in the cupola or other melting furnace so that the best type for the job can be obtained.

A good proportion of foundry scrap is generally employed in such mixtures, ranging from light shop scrap, such as runners, risers, etc., from small castings, to heavy shop scrap, which consists of heavy defective castings, heavy runners, and the like. This scrap may be mixed with a suitable quantity of new iron, or pig iron, different grades of which can be bought.

Alloying

In addition, iron is frequently alloyed with nickel, chromium, and other metals to give it special heat-resisting, durable, or other properties. The question of the composition and alloying of cast iron is dealt with fully in Chapter 2, to which the reader should refer for further information on this subject.

It should be noted that any scrap to be used for re-melting should be sorted over before being used. The use of dirty scrap, or scrap which has a large quantity of sand adhering to it, can only prove detrimental to the quality of the metal. In addition, special care should be taken while sorting to see that any unsuitable metal is removed.

Malleable Castings

Although castings are normally rather hard and brittle when removed from the sand, it is possible to produce castings that are less brittle and very tough. These qualities are produced largely by prolonged annealing (see Heat-Treatment of Metal), but annealing can only be really satisfactory if suitable iron is used in the first place.

Malleable castings are made in green-sand molds, and although the method of making the mold is the same as for any other type of casting, there are one or two points which, if borne in mind by the molder, will help to insure the success of the finished article.

A good fine facing sand should be used to produce a good *skin* or face on the casting; a mixture of cement and plumbago makes a good facing. It is also well to remember that the iron used for malleable castings tends to shrink to a greater extent than the ordinary iron, and larger gates and risers should therefore be provided. Shrink heads or feeders should be larger for the same reason, and they should be made wider at the bottom than at the top. This is done because metal for malleable castings is not very fluid and is liable to set rather quickly,

especially in the narrow neck of the runner, riser or feed-gate, and will thus impede the passage of feed metal to the casting.

Heat of Ladles

Ladles for malleable iron should be hotter than those used for ordinary grey iron, and they are frequently heated by filling them with metal from the cupola, allowing them to stand until they have become thoroughly heated through, and then pouring the metal back into the cupola. Some furnaces are provided with an aperture near the tap-hole for this purpose.

Chilled Castings

In case where certain faces of a casting are required to stand up to considerable wear while the body of the casting remains soft, chills are put into the mold as shown in Fig. 30. The molten metal coming into contact with the chill becomes very rapidly cooled; this prevents the formation of free carbon near the chilled surface and results in a very hard and durable surface.

Chills are made of iron, a close, strong grey iron, with a high melting point being the most suitable. They are usually dressed or blackened before use with a thin wash of blacklead or other substance that will not interfere with the cooling effect of the chill. Sometimes they are not dressed, but allowed to form a thin coating of rust, and smeared over with a little oil before being put into the mold as explained later.

The depth of the chilling effect may be regulated by the thickness of the chills. Skin chilling can be effected by means of chilling plates from half to one inch thick.

Chills sometimes crack through unequal heating, and if this is to be avoided, the molds should be filled as quickly as possible so that the whole surface of the chill may be similarly affected. Larger gates than for ordinary molds are therefore necessary.

The face of the chill that comes into contact with the casting should be carefully prepared in the first instance and thereafter kept in good condition.

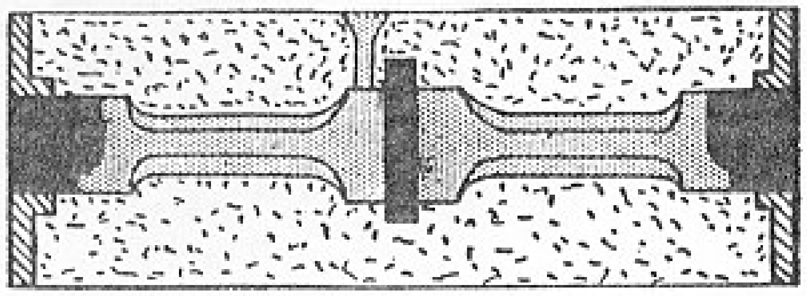


Fig. 30. In order to produce a durable and hard-wearing surface on certain faces of a casting, iron chills are inserted into the mold, as shown above. The diagram illustrates a mold for a truck wheel with chills for the tread and axle.

Frequently these faces are machined for accuracy and also to remove the outer skin of the iron. The removal of this skin is generally desirable because being cast iron, it is often of a slightly different composition from the interior, and if not removed might cause cracks or other blemishes to form on the surface. When chills are being machined, the greatest care should be exercised to avoid coarse tool marks.

On very smooth surfaces it is difficult to get the blacking to adhere properly, and in addition, the molten metal coming into contact with them will not lie quietly. In order to overcome these difficulties the smoothness may be removed by carefully rusting the surface, but no more than a very thin layer should be allowed to form. For this purpose chills are often exposed to the weather, or they may be treated with a very dilute solution of sal-ammoniac. Sometimes urine is used to produce the film of rust. The chill should be rusted uniformly over the surface, which is then rubbed over by hand.

Repairing Damage to Chills

It will be obvious to the reader that chills have to withstand very severe conditions. They must, therefore, be frequently inspected and kept in good order. Rough patches are liable to appear on the surface, and these must be rubbed down. A little blacking may be used as a filler where the damage is slight. Chills that have been in use for a long time lose their chilling properties and are liable to produce defects in the casting. This is due to the annealing effect of the hot metal coming into contact with them.

In order to reduce the danger of fracture, chills should be heated in a stove before being put into dry-sand molds, and the metal should be poured before they have had time to cool.

Brass, aluminum, and other non-ferrous metals are cast in sand molds in much the same way as iron. The making of the mold is in most cases the same as for iron, although, in the brass the flasks are usually poured vertically instead of horizontally. It is usual, when making molds for brass castings, to provide several in-gates from a central runner, while the runner itself should be somewhat wider than that used for iron.

With aluminum the most important point is the pouring temperature of the metal. This metal readily overheats, but if satisfactory castings are to be obtained, the temperature should not be allowed to rise very much above the melting point. Before pouring, the dross and dirt should be carefully skimmed off, and the metal given a vigorous stir. It should then be poured quickly into the mold in a steady stream.

Green-sand molds are generally used, and the cores are often made from sawdust with resin as a binding agent. With this metal hard cores tend to produce cracked castings, owing to the fact that they do not contract to the same extent as the metal itself. It is desirable to remove them from the sand as soon after pouring as possible. Owing to the lightness of the metal, heavy runners and risers are essential.

GLOSSARY OF TERMS USED IN THE FOUNDRY

ADHESIVENESS. The ability of particles of sand to cling to some other material.

BACKING SAND. Sand used to fill flasks after facing-sand has been used to cover the pattern.

BEDDED-IN MOLD. Mold the bottom half of which is made in the sand in the floor of the foundry. It may be covered with a cope, or cast open, according to the type of work.

BLOWN CASTINGS. Castings in which bubbles, or blowholes, have been caused through gases, steam, etc., generated when the mold is cast, finding their way into the molten metal.

BOT. Clay wedge used in a cupola to stop the hole through which the metal is run.

COD. A sand projection left behind in the mold by some patterns. Strictly speaking, it is a core, but instead of being inserted separately into the mold, it forms part of the mold itself.

COHESIVENESS. The ability of particles of sand to cling together.

COPE. The top half of a molding-box.

CORE. Sand facsimile of the interior, or hollow, portions of a casting.

CORE BOX. Box in which cores are rammed up and shaped.

DRAG. The bottom half of a molding-box or flask. It is rammed up before the cope.

FACING. Materials used in the foundry for painting the surface of a finished mold in order to produce a smooth skin on the casting.

FACING-SAND. Sand used to form the faces of a mold.

FALSE ODDSIDE. Permanent oddside made of plaster or other material. See Oddside.

FEEDING. Process of assisting metal to run into a mold to make up for any contraction of the metal as it cools.

FETTLING. Cleaning up, trimming and finishing of castings after they have been taken out of the sand.

FLASK. A complete molding-box, consisting of two or more parts. The term is often loosely applied to a half box.

FLOW-OFF GATE. Channel cut from the mold to the riser.

GATE. Channel by which metal may enter or leave a mold. See In-Gate; Flow-off Gate.

GREEN SAND-MOLD. Mold made and cast in damp sand. The opposite of a dry sand-mold, which is dried in an oven before it is poured.

IN-GATE. Channel cut from the bottom of the runner into the mold. It is used in cases where the runner does not enter the mold direct.

LADLE. Receptacle into which molten metal is run from the cupola and from which metal is poured into a mold.

LOOSE PIECES. Undercut portions of a pattern which are made separate from and fixed on to the pattern by pins or other means, in order that they may be left behind in the sand when the pattern is withdrawn and removed separately from the mold.

MOLD. Impression of the article to be cast. It is usually made in sand, but may be of metal.

MULTIPLE MOLDS. Molds which are stacked on top of each other and cast through a single runner. Each half box contains a half mold on each face.

ODDSIDE. Support used for supporting a pattern while the drag is being rammed up.

PATTERN. Facsimile of the article to be produced. It may be of wood, metal or other material, and is made larger than the casting to allow for contraction.

PRINT. Wooden projection put on to a pattern to provide supports for the cores in a mold.

RAPPING. Tapping of the pattern with a mallet in order to loosen it as it is drawn from the mold.

RISER. Channel from a mold used to carry foreign matter out of the mold or to assist in feeding the casting as it cools.

RUNNER. The channel down which the metal is poured into a mold.

SLEEK. Term meaning to make smooth. It is applied to the troweling of a sand surface.

SNAP-FLASK. Molding-box, hinged on one side so that it may be opened to allow the finished mold to be removed.

SPRIGS. Small pegs of wood or metal used to strengthen weak portions of a mold or to assist in the mending up of a damaged mold.

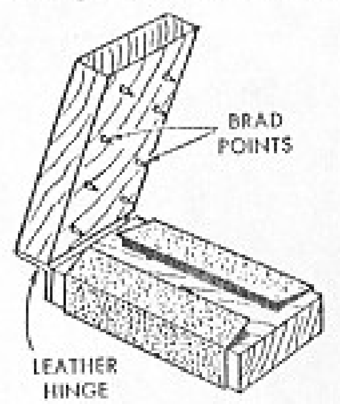
STRICKLE. Piece of wood by means of which surplus sand is removed from a molding-box or other surface. Strickles may also be used to shape sand surfaces in the mold.

VENT. Channel made in the sand in the vicinity of a mold to allow steam, gases, etc., generated when sand and molten metal come into contact with one another, to escape.

WASTER. Faulty casting.

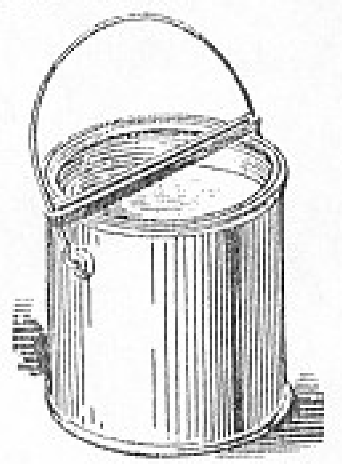
POPULAR MECHANICS

Hinged Blocks Hold Sandpaper



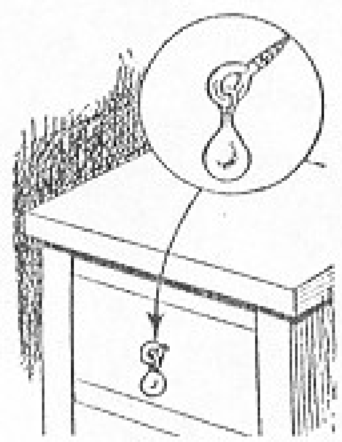
Here's a handy sanding block you can make in a few minutes. Hinge two blocks with leather and drive brads through the upper block so that the points project 1/8 in. to hold the sandpaper securely.

Rubber Band Holds Pail Handle



Often it's handy to hold the handle, or bail, of a paint pail upright. A rubber band snapped around the handle will do the trick nicely It holds the bail upright where it's easily grasped and at the same time it serves as a brush rest or wiper.

"Teardrop" Drawer Pulls



Casting sinkers of the type that are teardrop-shaped can be made into attractive and durable drawer pulls for a shop cabinet. Just open a small screw eye, attach the sinker and then turn the screw eye into the drawer front.

THE

MOULDER'S AND FOUNDER'S POCKET GUIDE:

A TREATISE ON

MOULDING AND FOUNDING IN GREEN-SAND, DRY-SAND, LOAM, AND CEMENT; THE MOULDING OF MACHINE FRAMES, MILL-GEAR, HOLLOW-WARE, ORNAMENTS, TRINKETS, BELLS AND STATUES; DESCRIPTION OF MOULDS FOR IRON, BRONZE, BRASS, AND OTHER METALS; PLASTER OF PARIS, SULPHUR, WAX, AND OTHER ARTICLES COMMONLY USED IN CASTING; THE CONSTRUCTION OF MELTING FURNACES, THE MELTING AND FOUNDING OF METALS; THE COMPOSITION OF ALLOYS AND THEIR NATURE.

WITH AN APPENDIX

CONTAINING RECEIPTS FOR ALLOYS, BRONZE, VARNISHES AND COLOURS FOR CASTINGS, ALSO TABLES ON THE STRENGTH AND OTHER QUALITIES OF CAST METALS.

BY FRED. OVERMAN,
MINING ENGINEER.
AUTHOR OF "THE MANUFACTURE OF IRON," "A TREATISE ON STEEL," ETC. ETC.

With Forty-two Wood Engravings.

PHILADELPHIA:
A. HART, LATE CAREY & HART.
1852.

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 THE SURVIVOR Vol. 5

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THE

MOULDER'S AND FOUNDER'S POCKET GUIDE.

CHAPTER I.

MOULDING.

The moulding of metals and other materials into the various forms, required for the accomplishment of certain purposes—whether of an economical or ornamental character—is an object of high interest. Moulding is the noblest of the arts; it serves with unvaried interest the fine as well as the useful arts. The heavy castings for the construction of machinery, to the weight of thirty tons and more; the statues of the ancients, and of modern heroes, are ornaments of human genius. The minute, well finished castings of iron and bronze are evidences of human skill and ingenuity.

Moulding may be considered in two distinct branches; the one is the moulding proper, the other

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the forming of the pattern. Moulding proper is almost the same in principle and in practice for each of the various kinds of metals or alloys. Slight variations in the materials for moulding, and in treatment, are the only differences in moulds which are designed to be used for iron, brass, bronze, tin, or lead, and other metals. The principal materials used in moulding, are, sand of various kinds, loam, plaster of paris, blackening, and metal.

Sand is the most common, and certainly the most perfect and convenient material. It is superior to all other materials for moulding. Sand is more or less porous, and very refractory, so that the hot metals do not melt nor bake it; two qualities of great importance in the successful operations of the business. The various kinds of good moulding sand, employed in foundries for casting iron or brass, have been found to be of an almost uniform chemical composition, varying in grain or the aggregate form only. It contains between 93 and 96 parts of silex or grains of sand, and from 3 to 6 parts of clay, and a little oxide of iron, in each 100 parts. Moulding sand which contains lime, magnesia, and other oxides of metal, is not applicable, particularly for the casting of iron or bronze. Such sand is generally too weak or too close; it will not stand, or retain its form,

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or it will cause the metal to boil by its closeness. In practice the different classes of castings require different kinds of sand for the purpose of moulding. For one kind of castings the sand is to be porous, open, and is still to be adhesive; for another class it is to be very adhesive and fine, almost free of grit, to make itself conform to the minutest parts of the pattern imbedded in it. At the proper places in the description of the process of moulding, we shall allude to the various kinds of sand best qualified for specific purposes.

The best moulding sand is generally found along the banks of large rivers; that procured from the shores of mountain streams, is in most cases too coarse or too poor and weak. Good sand, however, has been found on the very top of high hills. The best is generally found in the vicinity of the primary rocks, or along those river banks which receive their

supply from the primitive mountains. The alluvium of the transition or metamorphous rocks, as graywacke, slate, and feldspar, forms a very superior moulding sand, if it does not contain too much iron. In the coal districts there is generally little or no difficulty in finding good sand, for most of the river flats are composed of that useful material, which, however, frequently contains too much iron, and

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is liable to melt from the heat of heavy castings, an evil which can be modified by mixing the sand with coke-dust, or anthracite powder. In tertiary regions, and along the sea-coast, some spot is always found where fine and strong sand may be dug; in these localities the best kind is frequently deposited. The greatest difficulty in obtaining sand of a good quality, is mostly encountered in limestone and volcanic regions, also where porphyry, mica slate, and micaceous rocks predominate. Sand which contains too much iron or lime, or still worse, mica, will not adhere, and is liable to absorb and retain too much moisture, and cause rough and unsound castings. Good moulding sand has in its green state a yellowish earthy colour, balls easily on being squeezed in the hand, and, if sufficiently fine, assumes the finest impressions of the skin without adhering to it. White or gray sand is generally either too strong or too weak. Sand for undried moulds—green sand moulds—is generally more open or porous; it should not contain as much clay as that used for dried moulds, or it cannot assume or retain the finest impressions of the pattern. Sand for dry moulding is frequently of the finest kind, and very strong; for heavy castings a coarse but adhesive sand is mostly selected.

Core-sand.—The material most difficult to obtain is

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good core-sand. Core-sand should be coarse, very porous, but still very adhesive. Rock-sand—the debris of abraded rock—free-sand from river banks or from the sea-shore, pounded blast-furnace cinder, and other kinds of coarse sand, are frequently mixed with fine strong sand, or with clay; the use of the latter, however, is to be very limited. The best core-sand is frequently found on hillsides, or the very top of hills, in places where feldspathic or primitive rock has recently been decomposed, where the rock contains sufficient clay to make it adhere, and where the coarse angular grains have not supported vegetation, and it is consequently free of all vegetable or animal matter. Where sand of abraded rock cannot be obtained, free-sand, or, which is preferable, pounded blast-furnace cinder may be used, tempered with clay, barm, pease-meal, or horse-dung. In the use of the latter vegetable and animal substances, caution is to be exercised to prevent the boiling of the casting, because of the quantity of gas liberated from such matter. For cores, fresh sand must be used in each cast; old sand, burned sand, or sand mixed with coal, cannot be employed for this purpose.

Clay is frequently used for improving the adhesiveness of sand. It is to be selected from the white

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aluminous kind, argillaceous earth, or fine clay. It is either dissolved in a large quantity of water, and kept in the foundry for occasional use, or is dried, pounded, run through a fine sieve, and then mixed with the sand. The best plan is, to mix sand and loam together, and run this mixture moist through a mill; a common grist-mill, or a dust-mill, will answer for this purpose. One part of clay mixed with nine parts of free-sand, or any other pure sand, is considered sufficiently strong for core-sand; still these proportions depend very much on the nature of the sand, and the adhesiveness of the clay, and also what kind of cores are to be made from it. The sand for large and complicated cores, is to be stronger than that for small cores.

Loam.—Common loam, or clay of which common bricks are made, is generally used for loam-moulding. The loam ought to be as free from iron, lime, magnesia, and other alkaline matter as possible, because they make the loam too hard and close, and cause boiling of the metal. Such mixtures are also not sufficiently refractory to resist the heat of a large mass of melted iron. If good loam cannot be obtained, a mixture of sand and clay, as described above, is preferable to any imperfect loam. Loam, or any cement for loam-moulding, is to be mixed with saw-

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dust, horse-dung, hair, or cut straw, hay, or similar matter, which makes the loam adhesive and porous.

Coal-dust, *black-lead*, and *anthracite dust*, are simply means of blackening the mould, by mixing it with the sand or loam. If hot metal is allowed to be in immediate contact with some kinds of fresh

sand, the sand will partially melt, or if the sand is coarse, the hot metal will penetrate into the spaces between the grains, and the casting in consequence will be rough. Blackening, or a coating of carbon, will prevent in a great measure the burning of the sand, and consequent roughness of the casting. Black-lead is a very effective material for this purpose; but if used in too large a quantity it is apt to fill the necessary pores of the sand, and, as it is almost incombustible, will prevent the escape of gases from the hot metal, and consequently cause unsound castings. Next to plumbago in refractory quality is anthracite; and its dust, if not too fine, is an excellent means of preventing the burning of the sand. If there is too much anthracite dust in the sand, it will impair its strength; and if the dust is too fine, it will fill the pores of the sand. Dust of bituminous coal weakens the sand considerably, but it makes it very porous and open, thus facilitating the escape of the gas. It causes the castings to be very

smooth, but without fine impressions; it entirely detroys the sharp angles. Bituminous stone-coal dust appears to have a remarkable influence upon iron. Cast in a mould composed of sand and bituminous coal, the iron appears to be more gray and coarse-grained than when in any other mould. It is in consequence generally weaker; pig No. 2 improves by it. Coke-dust mixed with sand is better than any of the enumerated materials for making large castings, and for casting stove-plates. It makes the sand open, without impairing its strength too much. Coke-dust is not well qualified for face-dust; it does not make smooth castings. The most generally useful coal-powder is charcoal dust—ground charcoal of hard wood, such as oak, beech, sugar maple, hickory, or dogwood, well burned. Charcoal powder can be mixed with sand to nearly one-tenth of its volume. It is an excellent face-dust for small castings. Very small delicate castings require a very strong fine sand, free of all coal and coal-dust; these cannot be dusted with charcoal or any other dust, for such would impair the finer parts of the mould. Very small moulds are blackened by a rush candle, or the flame of a pine-knot.

Soapstone powder is a very efficacious means

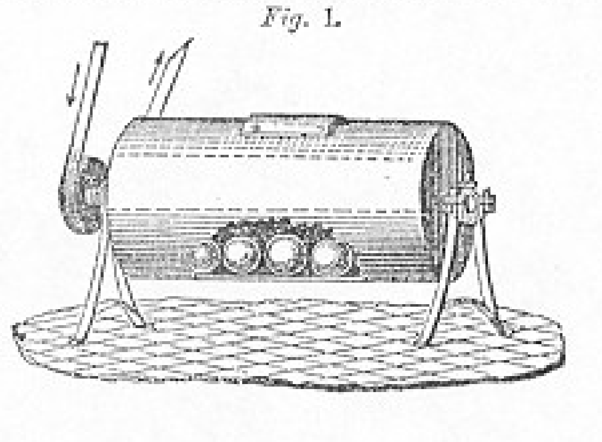
of preventing the burning of the sand. For thin castings, as stove-plates and hollow-ware, it is not excelled in making smooth, sharp castings. Its use, however, is not to be carried to an excess, because it is as weak as coal-dust, and finally spoils the sand of the foundry by making it too weak. Coal will burn out of the sand, but the magnesia of the soapstone will not; both cause porosity, as well as weakness of sand.

Sand, clay, coal of every kind, and blackening are so abundant in the United States, that we hardly need enumerate localities. Good moulding-sand is found everywhere along the eastern slope of the Alleghenies, from the old rocks of Maine, through the metamorphic strata of New Jersey to the Mississippi river, along the sea-coast in the tertiary deposit, or in the coal and gold regions of Pennsylvania, Maryland, Virginia, and the Carolinas. In the coal basins of the Allegheny, Monongahela, and Ohio rivers, there is no lack of good moulding-sand, and the same may be said of the valleys of the Missouri and Mississippi. Clay is also found there in abundance, and of good quality. Anthracite is in Pennsylvania, in Massachusetts, Ohio, and North Carolina, and where it is found, there is hard bituminous coal, or splint coal, which serves the same pur-

pose. Bituminous coal and charcoal are found in every region of the union. Plumbago is found in Pennsylvania, Virginia, North Carolina, and other places. Soapstone exists in Maryland, Pennsylvania, New Jersey, New York, and along the Atlantic coast. There is an abundance of good materials spread all over the United States.

Mills for grinding blackening.—Coal-dust is prepared in mills of a particular construction, to prevent the flying about of the blackcoal. It is commonly ground in iron barrels which turn around their own axis, and in which a number of cast-iron

Fig. 1.



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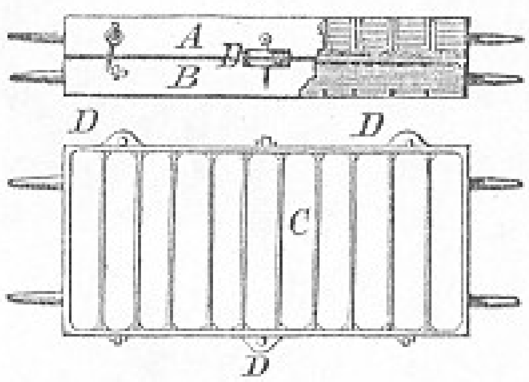
balls roll over the coal and break it, as represented in figure 1. Such an iron cylinder is generally from 2 to 3 feet in diameter, and from 1 to 5 feet long. It makes from 20 to 30 revolutions per minute, and is moved by a strap and pulley, or cog-
23
wheels. The number of balls, of which each one weighs from 25 to 50 pounds, is indifferent; the more there are at work the better. In the larger cities, as in Boston, New York, and Philadelphia, the manufacturing of blackening and dust is carried on by men who make an exclusive business of it. Remote and country foundries prepare their own dust.

TOOLS.

The instruments and tools used by the moulder are various and expensive. For moulding in green as well as in dry sand, boxes or flasks are used; these may be made of iron or of wood. Iron boxes are in the course of time the cheapest. For moulding in loam, iron plates, core spindles, wrought-iron bars, hoops and wire, are used.

Fig. 2.



Boxes or *flasks* are the enclosures of the sand,
24
which is filled around the pattern. A flask consists of two parts, as is represented in figure 2, where A is the upper box, and B the lower box. C shows the flask from above. The traverses, which are generally wider in the upper box than in the lower, are best made of wood, even if the box is made of cast iron. These traverses are moveable, and may be put into such positions as to suit the varied forms of the patterns. The three iron pins, D D D, are to be well pointed and tapered, and long enough to afford a safe descent of the one box upon the other. In case there are high projections on the pattern, these pins ought to be nearly as long as the flask itself is high. On each side of the flask are two hooks, fitting to eyes, which serve to connect the two parts of the flask as firmly as possible, to prevent a separation or the lifting of the upper box. These hooks are to be strong without being unnecessarily heavy. The eyes in which these hooks fit, are firmly fastened into the wood and clinched inside, or are cast into the iron when the box is being cast. On each box are four snugs or handles; these are for lifting and carrying the boxes or flasks. On large boxes, and also on very small boxes, there are but two handles, in the middle of the small side, strong enough to bear the weight of the box when filled
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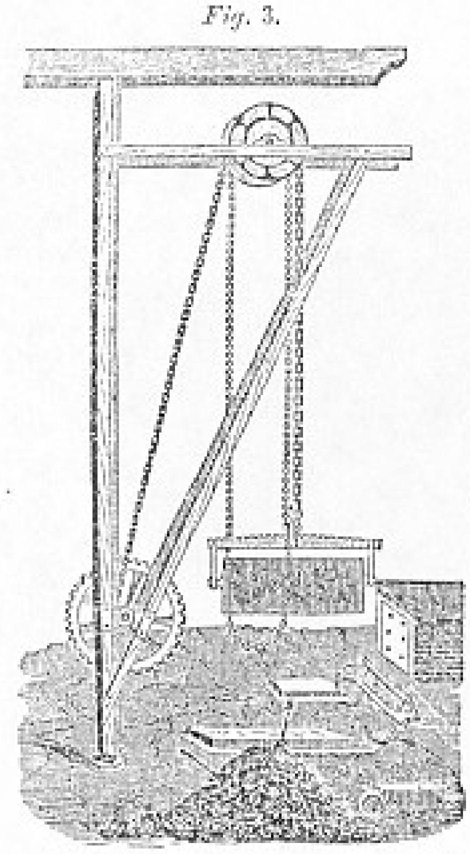
with sand. In this case the snugs, or swivels, are in the axis of the box; and if a box is suspended by a crane, it may be turned around its swivels, and be at rest in every position. Figure 3 shows a box

Fig. 3.



suspended from a crane, which in most instances is the proper way of lifting it. We see here that a box must be very strong to resist the influence of the heavy weight of sand and iron. If the box gives way, the sand will crack and drop out,
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spoiling the mould. Large boxes should always be made of iron. The form of the box is generally suited to the pattern; if the pattern is round, the box is made round. This close fitting of the box to the pattern is in many instances expensive; it causes new boxes to be made where often but one or two castings of a pattern are required. The only inconvenience resulting from square boxes, is the amount of dead sand in the corners of the flask,

which may be avoided by putting corners of wood or iron in the upper or both boxes. As in most cases the lower box is not moved, the weight of sand in that part of the flask is of little consequence; but where the nature of the pattern renders it necessary to lift and turn the bottom or drag-box, the corners of a square box may be spared just as well as in the upper box. The chief objection to a square box for round castings, is its weight; but where a strong crane is in the foundry, a little more or less weight to be lifted is of small consequence. In all cases, at least two inches space ought to be between the box and the pattern, and in case of heavy castings, more. This space is also to be larger in wooden than in iron boxes. When the space between the box and the pattern is too small, the mould is liable to leak, the hot metal will flow out if the

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parting between the box and the pattern is too narrow.

Flasks are to be as rough inside as they possibly can be made, for it is by adhesion chiefly that the sand remains in the box. In large flasks, the adhesion of the sand is increased by driving into the traverses and sides of the box, when the box is made of wood, nails of such a length that the points project on the inside. In cast-iron boxes, nails are either cast in the box, or its inner surface is covered with projections, made by driving the piercer an inch or so into the sand before casting the box; the latter mode is preferable. Nails are inconvenient in many cases, and in all cases troublesome; they frequently cause imperfect castings, as the sand never can be rammed as close where nails project, as where there are none. If the sand is not of a uniform closeness, the cast will be imperfect; for where the sand is too loose to resist the pressure of the fluid metal, the casting will bulge. A better method than the foregoing of making the sand adhere, is to put as many traverses in a box as can conveniently be done, and place them as close together as possible. The interior of the box is made wet, traverses and all, with a solution of

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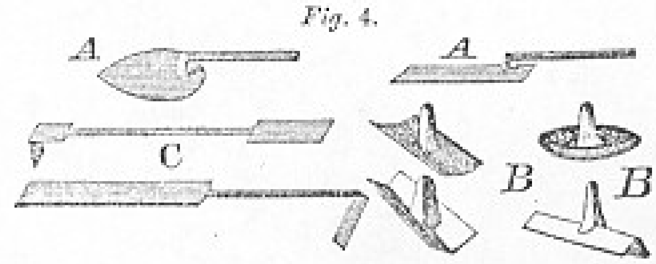
strong loam or clay. This loam or clay is put on by means of a whitewash or any other brush.

Moulding-boxes ought to be made of cast-iron; it makes strong and durable flasks. Wooden boxes cost less than those made of iron, but are more expensive in the course of time; they are liable to burning and leaking, and never make correct castings; their pins never fit well, and the wood is apt to warp. Hollow-ware, pipes, and ornaments are to be cast in iron flasks exclusively, or such castings are liable to incorrectness. Iron boxes are more heavy than wooden ones, which is objectionable, but, considering the greater security of the iron flask, the work may be done to more advantage than in wooden flasks.

Fig. 4.



Small Tools.—The trowels, Fig. 4, A, A, are from the size of a small mason's trowel, down to one inch long and half an inch wide. The trowel is used for smoothing down the surface of the sand, and clearing away superfluous sand, polishing the blackening or

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coal-dust, and repairing injuries in the mould. The whole of the trowel is generally made of metal, handle and all. B, B, are round forms of tools for polishing hollow moulds of a cylindrical or spherical form. C is a cleaner, often twelve and more inches long; it is used for cleaning and smoothing sunken surfaces, where the trowel cannot be used. These tools are generally made of steel, but are thus liable to corrosion, which injures their polish. The best metal for tools is hard bronze, as this is not injured by oxidation. A high polish and straight surfaces are the chief requisites of these tools. Their shape or form may be varied, according to individual taste. The general forms as represented, are the most in use.

Fig. 5.

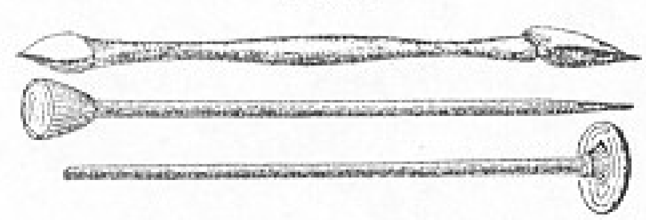

Fig. 5 represents both a wooden rammer and an iron one. The wooden rammer, edge shaped on both ends, is made on the turning-lathe, in one piece; it serves

for pressing the sand close into the corners of the pattern, and also into the flask. The other figure repre-
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sents an iron rammer, which, however, is merely cast-iron at one end, where there is a round button of from 2 to 4 inches in diameter on the face. The wooden shank or handle is generally tapered or pointed at the opposite end of the knob, for piercing the sand, or to reach more closely into corners. Each of these rammers may be from 2 to 4 feet long, according to the kind of work to be done with it.

Besides the tools here enumerated, the moulder has short-handled light shovels, for filling boxes and for working the sand; sieves of various sizes or meshes, and a riddle for filling the flask; small bellows, for blowing dry loose sand from the mouldings, and parting-sand from the pattern; and also, coal-dust or blackening. The moulder needs an iron pot for holding parting-sand, and also a water-pot; two or more linen bags for coal-dust, black-lead, and pease-meal; a piece of rope for tufts, for which paint-brushes also can be used. Piercers or prickers, are iron or brass needles, made of wire, from $\frac{1}{8}$ to $\frac{1}{4}$ of an inch thick; they are from 6 inches to two and more feet long, tapered the whole length, and drawn to a point.

Parting-sand, is that sand which is strewn over the moulding sand where the boxes separate; it is either free-sand, river-sand, sea-sand, or pounded cinder; or it may be the burnt sand scraped off the castings
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in cleaning them. *Pease-meal* may be substituted by any other meal; the first, however, is the best. Many tapered pins of various lengths, round, square, oval, and oblong, are needed in a foundry for making gits or gates; some strong, well-tapered and pointed screws for lifting out the patterns; iron hammers and wooden mallets, small crowbars, pinchers and tongs.

Moulding in green-sand.—There are three distinctions in moulding; green-sand, dry-sand, and loam moulding. Green-sand moulding is generally applied to light iron castings; as small, unimportant parts of machinery, stove-plates and stoves, hollow-ware, grate-bars and fire-grates, shot and cart-wheel bushes, water-pipes, gas-pipes, and many other articles. This method is seldom used for any other metal than iron. In making a mould for a small piece of machinery, say a wheel, in green-sand, the pattern is put upon a flat board, which is laid perfectly level upon the floor of the foundry, or, for small articles, upon a pair of trusses, or a box which contains sand. Upon this board the pattern is laid with its smooth side on the board. If the pattern is divided in two halves, but one half of it is laid down, the jointed side upon the board. Figure 6 shows the arrangement seen from above. The board is to be straight and well planed, and
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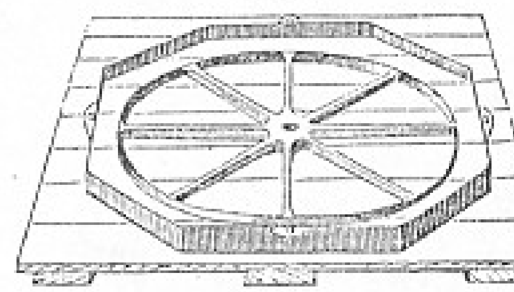
Fig. 6.



made of two-inch pine plank, or, if the article is small, but one-inch. After the wheel is laid down and well adjusted, or made solid by sprinkling some sand on those places where it does not touch the board, the lower box of the flask is put down inverted upon the board. Before the drag-box is put down, a layer of sand of one inch thick is frequently spread over the pattern and the board. In this sand the box is imbedded, and rests more firmly in it than upon the bare board; the box and pattern are not so liable to shake, or the board to vibrate. The first layer of sand upon the pattern is to be worked through a fine sieve: this sieve is to be finer, the smaller and thinner the pattern, or the more smooth the surface of the casting is to be. This facing-sand, or the first layer, is, in instances where a very smooth sharp impression is required, to be fresh sand from the pit, which never before has been in a mould. Of such fresh sand, a layer of $\frac{1}{8}$ to $\frac{1}{4}$ of an inch in
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thickness is to be sifted over the pattern. One inch, or, according to the pattern, a greater depth of fine sand, is to form the facing of the mould. All coarse grains of sand are to be prevented from coming in contact with the pattern. If the pattern is complicated, or contains many nooks and corners, the facing is pressed to the pattern by hand, to secure a uniform covering and a uniform tightness of the sand. After the facing is properly secured, common moulding-sand is thrown into the box through a coarse riddle, flush with the box. This sand is rammed down,

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cautiously and uniformly, with the wooden and edged stamper. When the first box-full of sand is secured and well worked into the cavities of the pattern, the box may be filled again by throwing in sand from the pile, which is repeated until the box is properly filled and of uniform tightness. The coarse, or last sand, is rammed with the round iron stamper, the superfluous sand is stricken off by running an edge rule over the box, so as to make the sand perfectly flush with the box. If this first, or the drag-box, has traverses, as shown in the drawing, there are often difficulties in getting the sand properly distributed over the pattern, and it is not easy to obtain a uniform compactness of the sand. Traverses in the drag-box are admitted only in cases of very

smooth single patterns. Most of the moulds are made without traverses in the lower box; it is considered more safe in working the sand, and the work is done easier and faster. When there are no traverses in the lower box, the sand, after being levelled, is sprinkled over with some loose sand and covered with a board, which covers the box all over; it is gently rubbed on, and the whole, box and board, turned over, so that the former bottom is now the top of the box. If the patterns are large, and the box is heavy, it is necessary to fasten both bottoms to the box by means of glands, so that no slipping of the boards may happen while the box is turned over. If traverses are in the box, and no bottom is used, a smooth place on the floor of the foundry is to be prepared beforehand, upon which the box is laid. In case there are no traverses, it is set upon a plank bottom. When the box is deposited in its proper position, that is, in that place where the casting is to be performed, the first bottom upon which the pattern was laid is removed, in which there is no difficulty, if the bottom is not fastened to the pattern. This bottom is frequently fastened to the pattern, which is done in cases where the patterns are limber; as is the case with light and ornamented railing, ornamented stove or fire-grate

plates. In this case a few gentle taps are to be given on the back of the board, either with a wooden mallet where the bottom is of value, or with an iron hammer; these taps will loosen the sand at the pattern, and there is less danger of breaking or injuring the facing of the mould. In this case the join-pins of the boxes are fastened to the drag-box, and are to go through the bottom to secure the exact position of the pattern in the sand, when repairs are to be made to the mould, in which cases the pattern is put in again after having been removed. In ordinary cases these pins are fastened to the upper box. In many instances no bottom for the pattern is used, but the upper box of the flask is filled with sand, rammed in and levelled; upon this the pattern is bedded, then the drag-box put on, and the work done as described above. It is a bad practice to work without a pattern-bottom; it is a slow way of working, the patterns are liable to be injured or bent, and the castings are never very fine or correct. After the bottom is removed, the upper surface of the sand-parting is smoothed down, and the superfluous sand cut away by means of a trowel. Pattern, sand, and box are to form one flush surface; this surface forms the parting. The parting-surface is thinly covered with parting-sand, gently sprinkled

on by hand; as small a quantity as possible is to be used, just enough to prevent the adhesion of the moulding-sand. As it is impossible to avoid throwing some of the parting-sand on the pattern, which, if left there, would cause a rough surface to the casting, this sand is gently blown off the pattern with a small hand-bellows. After the one half of the mould is so far prepared, the other parts of the pattern are put on, in cases where the pattern is divided; the upper box is then laid in its proper place, the hooks fastened, the facing-sand is put on; after which the common sand is stamped in; in short, the same operation is performed as previously described for the lower box. When the pattern is simple and smooth, there is not much difficulty in adjusting the traverses, which may be straight, and reach with their lower edge down to within half an inch of the pattern. If the pattern is not smooth, and parts of it project into the upper box, the traverses are to be cut out in those places where they touch the relief parts of the pattern. For these reasons wooden traverses are preferable to iron ones, because they can be easily fitted to any pattern. Many boxes have no traverses at all; this is the case with boxes of less than eighteen inches or two feet square.

Gates.—Immediately after the face-sand is put in

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the upper box, and before the second layer is thrown in, preparations are made for the *gits*, gates or passages for the metal. This is done by setting in wooden pins, very much tapered, and of a sufficient length to reach above the edge of the upper box. These pins are generally made of wood, and are of a great variety of forms, lengths, and thicknesses. The setting of these for gits is a nice point, and requires some discrimination on the part of the moulder; particularly where iron is to be cast, and where the patterns are very thin. On the distribution of the gits depends in a great measure the success of casting. If the pattern is of a heavy thick form, say more than half an inch thick in its thinnest parts, and its surface is not too large, one gate will be sufficient. In proportion as the surface increases or the pattern is thinner, the number of passages is to be increased. In most instances it is preferable to have the gits outside the pattern; but this always requires a somewhat larger flask, for which reason this rule is not adhered to. Thin plates require flat gits of a very oblong form; mere edges, in case the gits are to be set upon the plate or the casting itself. On round patterns, wheels, pulleys, or any others of that description, the gits must always be set outside. In all cases there is to be an air or

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gas gate, which is always set upon the pattern directly, whether the passages are inside or outside of the latter. For very light, thin, or open ornamental castings, it is often difficult to find the proper places for the gits, and it requires some experience to decide, at first sight, where to put the gates on a new pattern. Frequently more than one of the first castings of a new pattern are lost on this account. In all instances it is a rule to put the gits in such places that the metal may find the shortest way to fill the mould; where the metal, in passing through the narrowest parts, will find wider and heavier channels to b filled, so that the partially cooled metal may unite again in the heavier parts of the mould. If one passage is not sufficient, there are to be two or more; in fact, as many as are necessary to secure success. The fluid metal is to be poured into all the gits at once, whatever number there may be, so as to fill the mould in the shortest time, and promote a union of the metal from the various passages.

When boxes, pattern, and gits are in their proper places, the flask has the appearance of Figure 7. When the upper box is well filled with sand and levelled, the hooks are unfastened, and the top box gently lifted by one, two, or more men, or, which is

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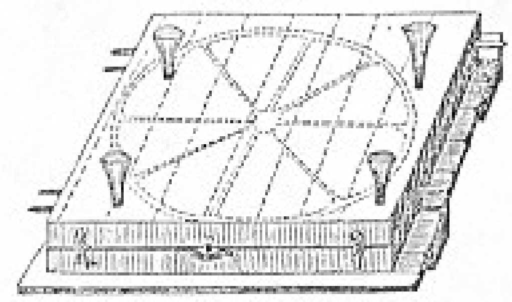
Fig. 7.



safest, by means of a crane. The box is then set on one edge, or turned edgeways in the crane; the pins for the gits are then withdrawn, and the tapering holes are cut larger, bell-mouth shaped, at the top of the flask. The gits are to be very tapering and smooth, to allow an easy passage for the hot metal, and prevent the washing down of loose sand. When the upper box is well mended and secured, and ready to be put on again, the pattern in the lower box is removed. Before this can be done, the edges of the sand all around the pattern are wetted, which is done with a swab, or with a paint-brush soaked in water, and pressed gently between the fingers while running it over the mould. In that way a greater or smaller quantity of water may be thrown on the edges, as the workman may find it necessary. The sand is now examined with the finger all around the pattern, in order to ascertain if it is of a uniform closeness. If too loose, so as not to resist the with-

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drawal of the pattern or the influence of the hot metal, it is pressed down, and some fresh sand worked in with the trowel. If the sand around the pattern is uniformly close, the trowel is used for smoothing the whole surface, and then the pattern is withdrawn. To withdraw a pattern is in many instances a delicate operation, for the sand will more or less adhere to it and damage the mould, in case the pattern is lifted without being properly liberated from the sand. To free the pattern from the adherent sand, the lifting-screws are put in, after which it is loosened by striking it gently downward with

a wooden mallet. In lifting it, it is to be tapped sideways against one of the corners of the pattern, or against the lifting-screws, or against studs made for the purpose.

The lifting-screws are sharp-pointed and tapered, and of a coarse thread when the pattern is of wood. In metal patterns the thread is cut into the pattern, fitting the screw. Richly ornamented or carved patterns, or those of complicated machinery, are seldom lifted without breaking more or less of the mould, and damaging it. The moulder repairs such damages by putting some water on with the swab, and adding as much sand as appears to him sufficient for filling the break. The more prominent parts receive

a touch of the swab. The pattern, when removed, is well cleaned by means of a dry brush, and laid in the sand again, in its former bed. With simple patterns this latter operation is not necessary: a skilful moulder can repair a damaged mould without resorting to this expedient. In ornamental moulds there is, however, no chance of successfully repairing a break. The pattern is once more pressed down to its former site, and then withdrawn, the mould generally being then found to be perfect.

Blackening the mould.—By shaking a small bag filled with blackening or ground charcoal, over the mould, it is covered with a thin film of coal-dust. This dust is to be distributed as evenly as possible. If fresh sand has been used for facing, the dust will adhere to the sand, and the pattern, after being well brushed over, may be laid in again to smooth the dust down. The sand around the pattern is smoothed with the trowel. If the mould is faced with old sand, the dust is not likely to adhere, and may be blown off, which is to be avoided. In this case a coating of fine meal is given to the mould; any meal will answer for this purpose, either rice, corn, or pease-meal. If meal has been used before the dust is put on, it is not advisable to put the pattern again in the mould, until a heavy coating of dust has been given over the

meal. Care must be taken in using coal-dust or meal, as both cause dull castings if used to excess. The best and smoothest castings are made where the facing consists of a thin coating of fresh sand, and with as little blackening as possible brought upon it.

Skilful moulders will however succeed in putting in the pattern again, whether they have been using meal or not. When the sand is well smoothed down, and the pattern laid in again, the channels or passages are scooped out of the parting surface. The pins which formed the gits, have given an impression in the sand of the lower box. Between these impressions and the pattern, channels are dug a quarter of an inch or more deep: where these channels join the pattern, they are seldom more than of the above-mentioned thickness, but may be thicker and narrower towards the gate; the channels must be thinner at the pattern than anywhere else, to make them break close to the pattern, when broken off. If one of such channels is not deemed sufficient, two or more may be cut from the same gate; the channel also may be widened towards the pattern, to afford a sufficient inlet for the metal, and may be swabbed, to give greater security against being washed away by the hot metal. After this is done, the pattern is taken out once more, the upper box

put on gently, the hooks fastened, and the mould is ready for casting.

When parts of the pattern project into the upper box, or the pattern is divided, the same process is to be followed with the upper, as has been done with the lower box. In this case the upper part of the box is to be covered with a board after the gate-pins are withdrawn, and the box laid upon its back, so as to have that part of the pattern uppermost, which is to be withdrawn. The process of lifting the pattern is here exactly the same as in the lower box, except that more caution is required in patching up damages than in the lower box, to prevent the dropping of sand when putting this box on the other.

When a pattern is fastened to the pattern board, it is lifted out before the upper box can be filled with sand. In this case the upper box is filled over a smooth board, well polished with the trowel, and put on without further preparation. It is preferable in this instance to bear the upper box down by weights of pig-iron, instead of hooks. This mode of moulding is easy and works fast, but is only applicable to very tapered and low patterns.

Composition of Moulding-sand.—Although moulding in green-sand at first sight appears to be so

simple, yet great difficulties, and often failures, may

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be encountered by not observing certain practical rules. The composition of the moulding-sand is of the first importance. If the sand is too strong, that is, if it contains too much clay, it is only fit for small or very thin castings. In this instance, care is to be taken not to make it too wet, for it absorbs a great deal of water without showing dampness, but it is soon found to be too damp for casting. Such fat, strong sand may be improved by burning it, or by continual use. It may also be improved by a mixture of charcoal-dust, coke-dust, or anthracite-dust. If too much coal-dust is used to make the sand work well, the castings are apt to be rough. Such strong sand is to be avoided for heavy castings. The heavier the cast, the poorer and coarser the sand is to be. Fine moulding-sand is liable to the same objections as strong sand; it works well in small moulds, if mixed with charcoal-dust, but it will not do for heavy castings. A large mass of hot metal generates a great quantity of steam in the moist sand, also compounds of carbon, which gases require vent: open coarse sand is necessary to give that vent. Core-sand is always coarser then moulding-sand, and seldom fit to be mixed with it. Where many cores are used, whether large or small, it is advisable to carry the castings to some spot in or out of the

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foundry, where the cores may be withdrawn and broken without their sand mingling with the moulding-sand of the foundry. A lot of good, well prepared old sand, is of great value in a foundry; its proper aggregation ought to be kept up by daily additions of fresh sand, or is liable to become too weak in the course of time. After each casting the sand is to be wetted with as much water as is required to give it the dampness necessary for its adhesion. The amount of water differs in almost every instance, and can be determined only by experience. All the sand of a foundry ought to be riddled at least once a week, to free it from chips of wood, pieces of iron, lumps of burnt sand, and similar matters, which produce inconveniences in founding. If green sand is rammed too tightly, especially for large castings, it is frequently broken, and bad porous castings are the consequence. This happens because the confined steam or gases cannot escape through the sand, and in rushing over the face tear it down. The running in of the piercer, to make artificial air-holes, is in such cases of great service, but is almost ineffectual in large or thick castings. It needs open, porous sand, to make the best kind of vent. Vent-holes pierced or left purposely, will never replace the advantages of open sand. If the

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sand is not rammed tight enough, the liquid metal is apt to break down all the projections in the sand, and by its fluid pressure cause unevenness and swelling of the mould, and in consequence imperfect castings. Each kind of sand, and each form of pattern, requires a different treatment to insure success. Too loose open sand, and too much coal or blackening, will make rough, imperfect, dull castings. Fine or strong sand is liable to cause boiling, explosions, or porous castings. Many of the difficulties may be removed by a skilful moulder; still it cannot be expected of him to make smooth sharp castings in coarse sand, or in sand which contains too much coal. The skill of a green-sand moulder is more frequently put to the test, than that of any other artisan. Every different form of pattern, different sand, different coal, different metal, and different locality, makes it necessary to modify his mode of working.

Division of labour.—The most successful way of overcoming the practical difficulties of green-sand moulding, is to divide the business into branches, so that each different kind of casting may be carried on in its own appropriate locality, and with its own proper workmen and materials. The sand suitable for heavy machine castings, is not fit for moulding small cog-wheels, less so for hollow-ware, and still

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less proper for ornamental carved castings. The moulder who has been trained to small articles, is hardly able to do heavy machine work; and those moulders who have been used to moulding heavy articles, cannot at once compete with moulders of light castings. To work successfully in green-sand, it is almost absolutely necessary to divide the articles of manufacture. There ought to be a separate shop, and separate hands, and particular sand for heavy machine-frames; a division for small machine-castings; a separate foundry for hollow-ware and stoves; and another for casting ornaments and railings, for

brass and for bronze. Each branch of these articles of founding requires peculiar conditions under which it can be most perfectly done, and carried on with the largest profit. The author has observed an instance where a moulder had been making, for eight consecutive years, a certain kind of flat-bottomed pot, with great success. No other moulder could earn half as much on the same article, nor make it equal in quality. This moulder could not make anything else but that pot; he failed in everything else he tried. Moulding generally is a very particular art, but green-sand moulding more so than any other kind of moulding, if we wish to economize in the prosecution of the business.

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Moulding in open sand is frequently resorted to, to avoid the making of flasks. It is in no way cheaper than moulding in boxes, and the castings are always rough and uncouth; but there are instances where it cannot be avoided. To mould in open sand, a particular bed is prepared in the foundry. The ground below it is dug out to the depth of two feet below the level of the foundry floor. This hollow is to be as large in extent as the largest mould to be made; a little larger does no harm. It is filled with coarse charcoal, coke, or anthracite-dust, or even with small, say half-inch pebbles, in the bottom. Upon this bed of open matter, two inches thick of the coarsest mould, or river sand, is riddled, and upon this common moulding-sand is sifted. When the bed is so far prepared, two straight edge-rules are put edgeways, one on each long side of the bed. These rules are adjusted by a level, so as exactly to range with each other, as well as with a horizontal line. If now an edge-rule is drawn slanting over these edges, it of course will cut the sand between the rules down where it is too high, and will fill any cavities there may be. As this surface of the sand will still be rough, even after this levelling is accomplished, some fine sand is now sifted over the whole surface, and a long straight wooden roller, of about

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six or eight inches in diameter, and long enough to reach over both edge-rules in the ground, is rolled gently backwards and forwards over the bed, care being taken that the edges of the rules are clean, and that the roller never misses them. This operation will smooth the surface of the bed; and in case the sand is not considered sufficiently solid, some more fine sand is sifted on, and the roller used to press it down. This process may be repeated as often as it is found necessary, until the sand is sufficiently compact to resist the pressure of the fluid metal. After finishing the bed, the rules are removed. Upon this level bed the pattern is laid; if it has any projections, these are turned downwards and pressed into the sand; the largest part of the pattern however is left above the sand, particularly if the pattern forms a plate. Around the pattern, which is to have a straight surface, some sand is piled by hand to form a dam all around the pattern, and flush with it. After the pattern is withdrawn the sand-dam forms the enclosure, and must be strong enough to resist the pressure of the fluid metal. On a convenient side of the mould the channel is elevated; that is, a place on the top of the dam is made broad enough to receive the fluid metal, and distribute it gently over the mould. If there are any cores in the

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mould, these are to be held down by pieces of iron, to prevent their being lifted by the fluid metal. After casting, the hot congealed metal should be covered by a thin coating of sand, to prevent its radiating too much heat into the work-room. This kind of moulding is hardly ever used but for the roughest kind of iron castings; it is seldom applied to other metals. It is mostly in use for foundry utensils, as plates and platforms for the loam-moulder, furnace-plates, grate-bars, and the like articles. Plates of any size and form may be made without pattern: the edges are then formed by rulers, and the corners by wooden squares of the desired angle. The thickness of such plates is determined by the amount of metal poured into the mould. Rough flooring plates, rough railing, and other indifferent castings, are sometimes made in open sand.

Moulding in one box.—In castings which are to be made from smooth patterns, and where no great accuracy is required, the pattern may be sunk into the foundry floor and covered by a box. Every foundry floor is considered to consist of sand, at least a couple of feet deep. A ditch is dug, or a place as large as the pattern, and every coarse piece of burnt sand, nails, iron, &c., removed, by riddling the sand. If the place is too dry, some water is

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thrown over it, and if too damp, dry sand is thrown over until it is so far elevated that the moisture will not injure the casting. The place is to be level. The pattern to be moulded is laid upon the sand and pressed into it, and the sand worked against the pattern by hand. The filling-up around the pattern is to be flush with the pattern, and to extend far enough to resist the pressure of the fluid metal. Upon this mould, which forms the lower box, the upper box is laid, and kept in its place by four or more wood-poles, driven around the box into the ground. This upper box is managed just as any other upper box, with only this difference, that weights are used to bear down upon it and resist the fluid pressure of the metal. If a pattern is large, and there are no means in the foundry to lift a heavy box, and if the upper side of the pattern is smooth, the mould may be covered with iron frames in the form of open network, cast in open sand, and covered with a coating of coarse loam, well dried. By joining the edges closely where these plates meet, a casting may be made just as good as if an upper box had been used. Castings made in these kinds of moulds are never so good as if made in the regular way in two boxes; moulding in this manner is admissible only where necessity compels, and quality is no desi-

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deratum. It is in rather more general use than there is need for. In a foundry where large machine castings are made, it requires much room and considerable dead capital to keep a sufficient stock of flasks, but the interest on capital thus invested is easily paid for by the facilities and security afforded in moulding, and the better quality of the castings. Moulding in the floor of the foundry answers for some kinds of pig-iron better than for others.

Moulding of a Cog-wheel.—Heavy green-sand mouldings are very frequent, and it will not be amiss to describe the moulding of a large piece. We will select the moulding of a large face-cogwheel. Some of the wheel-patterns are divided into arms and circumference, which is on many accounts preferable to other methods, but particularly on account of exactness. A wheel cast to its spokes is never round, as the arcs between the arms stretch in cooling. We will adopt a wheel with arms, and these arms divided on account of their cross section.

Fig. 8.

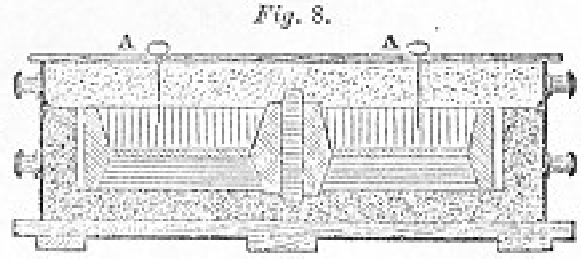

Figure 8 is a vertical section of a flask filled with

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sand, and ready for lifting the upper box. The different shades of the sand indicate what belongs to the upper and what to the lower box. In a wheel of this kind the face of the wheel is square, as a matter of necessity; no tapering is permitted, as in patterns of other descriptions. The inside of the rim may be tapered, and as the spokes of the wheel cannot be lifted from the lower box, only the spokes are divided so as to lift one half of each with the upper box. The lifting of the upper box is now not difficult, since a part of the pattern is carried with it. The part of the pattern which belongs to the upper box, is fastened to the box by the screws A, A, which pass through the sand, and are fastened to planks on the top of the box. These screws are drawn tight, so as to leave no space for any motion of the pattern. The half pattern in the lower box is withdrawn, by lifting it perfectly vertical and in all its parts at once. This work is done by several men; ten or more hands are often required to perform this part successfully. While the pattern is being raised, the men lift with one hand on iron pins firmly screwed into the pattern, and strike the pattern gently but in rapid succession, so as to loosen the adhering sand. Before the pattern is lifted the damages done by removing the upper box are repaired, which is easily ac-

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complished by using some damp sand and the trowel. In case the sand is not very porous, it is pierced close to the pattern, to make air holes for the escape of the gases. The number of holes required depends entirely on the quality of the sand; close, strong, or fine sand requires more vent-holes than that which is coarse and open. If the pattern in the lower box is smooth and varnished, the swab may be used liberally, but if not, or if the wood is porous or coarse, but little water is used, and the pattern is to be withdrawn as soon as possible. It is altogether a good rule in moulding to work fast,

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and withdraw the pattern from the sand as soon as possible, particularly a wooden one. It is no advantage to a metal pattern to remain long in the sand; no pattern ought to remain there over night.

It is almost unavoidable to prevent injury to the mould, particularly at the periphery of a cog-wheel; the sand between the teeth will be always more or less broken. To repair these injuries, one or more single teeth are generally supplied by the pattern-maker, of which two at once may be set in and the sand between the two filled up by means of a long sleeker. A preferable mode is to have a segment of the wheel, of at least three teeth; such a segment may be easily withdrawn, and gives more

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correct divisions. To work with loose teeth requires great experience not to injure the division or pitch of the wheel. Other parts of the mould are generally simple, and if any injury is done it is not difficult to repair such with damp sand, by means of the trowel or sleeker. A long, well made, and polished sleeker is of great service in moulding wheels. The mould is well polished over, after the pattern is withdrawn and every broken part mended; it then receives a slight sprinkling of charcoal-dust, and is again polished.

When the lower box is finished, the upper box, which is still fastened to and suspended in the crane, may be turned over and laid upon its back. If the box is too heavy, or the means insufficient to turn the box, it is left suspended in the crane as it is, face down. Some temporary supports however ought to be erected below the box, to hold it in case the chain of the crane should break, which would endanger the life of the workman engaged in repairing injuries. All the work to be done at the upper box is in this case accomplished from below the box. While one workman is below, first mending and wetting, and then watching the mould, others unscrew the pins from above, and in case there is any danger of sand breaking loose, the unscrewing is stopped, and the

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doubtful places soaked with water, and firmly pressed. In many instances hooks of small wire, wet in clay-water, are stuck around the edges of the pattern in the sand. The pattern, after every injury has been repaired, is removed, the mould polished, and the upper box is then ready to be put on the lower. In this instance no coal-dust can be used in polishing the mould; the casting, therefore, will be rough at the upper side. In all cases of divided patterns the better plan is to turn the top box upside down, which gives an equal chance to the upper as to the lower box; the proper work can then be performed on it. To turn a box upside down, requires a suspension of it on two points or swivels; the box must of course be strongly made. In lifting, too much attention cannot be paid to the uniform and vertical raising of the box; the least twisting of it will break the sand and cause injury to the mould. Boxes made too weak are very apt to bend, and often cause the falling out of the sand altogether. After the upper box is well repaired, the gits ready, and the channels cut in the lower mould, the flask may be closed. Hooks are useless on large boxes; the only means to keep the upper box down against the pressure of the fluid metal, is by weights or screws. Planks are laid over it to prevent damage to

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the mould, and the weight, which may consist of broken pig-iron or any other heavy metal, is gently laid upon these planks; in this way the pressure is more uniformly distributed. The gits to a wheel should be between two spokes, near the periphery, and two or three channels cut from each git, either to the spokes, or, preferably, to the spokes and rim. For a large wheel there are to be at least two gits—three would be better. There are also to be some flow-gates, one in the centre and two or more at the circumference. The gits should to be large, say two inches wide, and also have a wide trumpet-shaped mouth. The channels which conduct the fluid metal from the gits to the mould, are to be smaller in section than the git; for in pouring the metal the git is to be kept full, to avoid the passing in of impurities, as coal, dross, or sand, which may float on the metal; such impurities would injure the casting if permitted to pass into the mould.

Failures from some unforeseen difficulty frequently take place in the moulding and casting of large patterns. Fine strong sand is never to be used for heavy mouldings in green-sand; it invariably causes boiling, or at best, causes the castings to be porous and full of holes. If fine sand is mixed with much coal-powder, it is liable to be too weak to resist the

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pressure of the metal, or even the drawing of the pattern. It requires too much coal to make fine sand porous enough for heavy castings. Coarse open sand is the best for heavy castings where a large quantity of metal is poured in a mould; such sand however makes rough castings, which can be remedied in various ways. The mixing of coal-powder with coarse sand is not to be recommended, for it makes the sand too weak, and causes the generation of too much gas. Open porous sand, free from coal, can be used to advantage, if the pattern is covered with a layer of fine sand, say one quarter of an inch thick, or such thickness as is sufficient to resist the pressure of the iron; a very thin coating is in most cases sufficient. Such a coating of fine sand, well dusted and polished, will make smooth castings. Coal is not of much use in sand for heavy castings, for if the iron retains its heat long, as it does in ponderous masses, it destroys the coal nearest to it, in consequence of which the casting assumes a peculiar roughness. The only coal which resists the influence of hot iron in large masses, is plumbago or anthracite, but these, if they are so fine as to make a smooth surface, are too fine to admit the free escape of the gases, and if such carbonaceous matter is coarse, it causes as rough castings as coarse sand.

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In practice, coal mixed with the sand is advantageous, but it is not to be in excess, and coke or charcoal-dust are to be preferred on account of their peculiar porosity. But in heavy castings, coal can never prevent the metal from penetrating between the grains of sand; and if coal is of no service on the facing, it is of none in the body of the mould. Heavy castings are therefore best made in dried sand or loam, as we shall hereafter describe. Machine frames of a large body of metal, or of little importance, may be moulded in green-sand; but frames which are to be strong, wheels, or beams, ought to be cast in dry sand, for the unequal shrinkage of iron in wet sand, caused by the moisture, is very apt to impair the strength of a casting.

Mouldings of more than two boxes, are not so frequent, and are generally avoided in moulding machine frames. Many a complicated pattern may be moulded in two boxes, if properly managed. If no division of a pattern can be devised to meet all the difficulties, the moulding with cores is resorted to, to meet the emergency. We will illustrate this in one instance. Figure 9 represents a flask in which a pulley is moulded. The pattern of the pulley is divided at the dotted line. After the lower box is filled and turned, the sand is cut out around the

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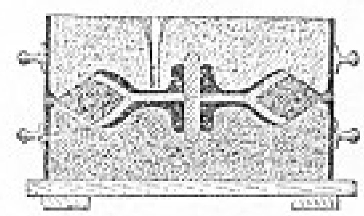
Fig. 9.



circumference as indicated, the surface of the sand smoothed and parting-sand sprinkled on, which is carefully brushed or blown off the pattern. The other or upper part of the pattern is now laid down, and a core of fresh moulding-sand pressed carefully into the groove of the pulley, in the form as indicated. This core is filled flush with the pattern, and slanted towards the edge of the box. It is well polished, covered with parting-sand, and then the upper box put on and moulded. When both boxes are filled, the flask is covered with a board and turned upside down, the drag-box is then lifted off first, and the lower half of the pattern removed. After this the flask is once more closed and turned, putting it this time on its bottom part. The upper box is now lifted, and the other half of the pattern removed. While turning the box, and lifting the pattern, the very brittle round core of green-sand is here always supported, without danger of its breaking. In a similar manner many complicated

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patterns may be moulded, by simply putting in cores of this kind. Where green cores cannot be applied, dry cores must be used, and the spaces for such provided for in the pattern; but of these hereafter.

Small articles of machinery require in many instances very skilful workmen, and a dexterous handling of the patterns. There is no branch of mechanics where more perfect castings are required and made, than for spinning machines. These castings are to be true, smooth, sound, and malleable, conditions which are not easily effected. To succeed well, it requires particular sand, and a certain amount of coal mixed with it, and workmen who are

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experienced in that kind of work. Many advantages, however, may be given to the moulder in the arrangement of a pattern. If a small face-wheel is to be moulded, and the teeth are to be parallel, it is difficult to mould such a pattern. If however a ring of lead is cast around the wheel, so that each space between the teeth of the wheel is occupied by a lead tooth, and the wheel may be drawn through the lead without difficulty, the moulding of such a small wheel is rendered comparatively easy, by laying the lead ring upon the sand around the wheel, when the weight of the lead will hold the sand down, which otherwise is apt to fol-

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low the wheel, particularly that portion between the teeth. In moulding small machinery of iron, it is not so much the smoothness of the castings which is to be considered, as the soundness of the metal; for this reason, the sand of such a foundry will bear and requires more coal-dust in admixture, than other foundry sand.

Ornamental Moulding.—The moulding of ornaments and railing is a subject of some interest, besides being a branch of the fine arts. Railing of simple forms, with one side smooth, may be cast in open sand; but there is the objection against it that open castings, made of the same metal, are never so strong as those cast in flasks. There is no economy in casting railing in open sand. For coarse railing, open porous sand is used, containing a good portion of coal. Here we have to remember that coal causes faint dull castings; the outlines are generally imperfectly developed. Carved work or sharp outlines can never be expected to be good if too much coal is used, either mixed with the sand, or dusted on. In ornamental moulding, it is not generally the strength of the metal which is the most valuable, but it is the perfect representation of the pattern which is desirable. Sharp outlines and smooth castings are the object of the moulder in this case. Some coal mixed

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with the sand, is necessary, but it ought to be as little as possible. To secure sharp castings, the facing of the mould is made of fresh fine sand; a layer of one-twelfth of an inch thick is sufficient, and this dusted with fine dust made of oak or hickory charcoal. Ornamental work always is and can be sufficiently tapered to leave the sand readily, and if the pattern is made of metal, and well polished, it may be repeatedly laid in the mould, and all imperfections of the mould may be repaired to the most minute correctness. Dusting the facing of the mould is the very last operation; every damage is to be repaired with fresh sand, and every line of the mould is to be correct before the dust is put on. There is no more coal-dust shaken over the mould, than is just sufficient to make a smooth casting. Pease-meal or any other meal is inadmissible in ornamental moulding; it is injurious to the sharp outlines of the casting. Common pannels of railing are generally smooth on one side, and may be cast in wooden flasks; but where both sides of a railing are ornamented, iron boxes are to be chosen. As an illustration of ornamental green-sand moulding, we will choose a square hollow column or railing-post, represented in figure 10. Figure 11 is the post represented in a section cutting through the post and the flask. The pattern

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Fig. 10.

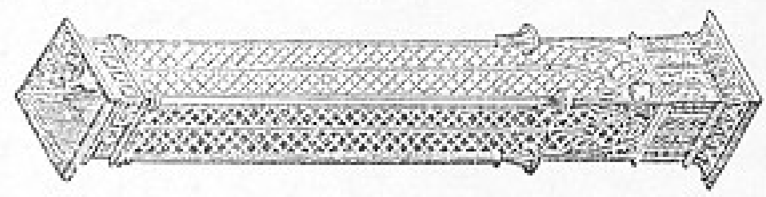
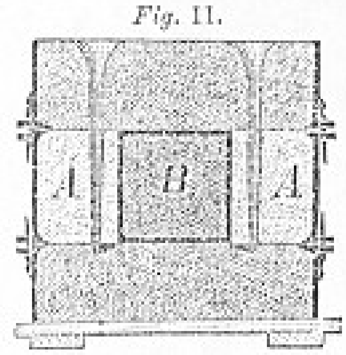


Fig. 11.



is divisible in four parts; it divides on each corner. In moulding, one of these parts or one side is laid on a board, and the lower box filled over the pattern; the box is then turned, the sand smoothed, and the two other parts A A put on. To keep these parts of the pattern in their places, four or more small square boards are put between them. These boards are of exactly the size to fill the inside, B, of the square. Parting-sand is now thrown on, and the middle box put in its place. The middle box is divisible on both ends, kept together by hooks, so that each part, A, of the box can be removed by itself. The spaces, A A, and B, are now rammed in and filled flush with the pattern and the box. After this the fourth side of the pattern

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is put in its place, which forms the top; parting-sand and the upper box put on, and this box rammed in. The pins for the gits are to pass through the middle box into the lower; and if the metal is to be not more than half an inch thick in its thinnest parts, it requires four gits, if thinner, six gits. On each end of the column a flow-gate is set upon the upper part of the pattern. When all the boxes are filled, and the gate-pins in, the top is covered with a board, and the flask inverted. The drag-box is now lifted, and the side of the pattern removed. The four parts of the pattern are to be fastened, each to its respective box, by means of screws passing through the sand into the pattern. Each of the four sides of the pattern has its taper towards the box. This lower part of the mould is to be well finished before closing, for there will be no opportunity of getting at it again. The small square boards, B, are now withdrawn, and the spaces left by them in the core, filled up with sand. When the requisite work on this side is performed, the drag-box is put on again and the flask reversed. The git-pins are now withdrawn, the upper box with its part of the pattern removed and put aside, until both parts of the middle box are ready. The pins which hold the middle box to the lower, are not to fit too closely, or are to be moveable, for the parts

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of the middle box are to be drawn in an angle, because it cannot be done straight. The process of withdrawing the pattern from the middle and upper box is simple, and requires no particular description. For this kind of work a somewhat open sand, or fine sand mixed with ground coke or ground charcoal, is to be used. Too close or too strong sand is liable to cause explosions in this case. Many apparently complicated patterns may, like this pattern, be very easily moulded, and by simple means, if they are properly divided.

Moulding of Hollow-ware.—The distinct objects of this branch are, however numerous, still of great similarity. In no branch of the art of moulding is skill and dexterity brought to such perfection as here; it is the result of the division of labour, practised in this department. The objects belonging to this branch, are pots, kettles, fire-grates, stoves and stove-plates, grate-bars, locks, latches, hinges, and all such articles, which are standard articles of commerce. In this case it is not alone the sharp, well expressed outlines of the pattern which are essential; besides these, well finished articles require smooth surfaces, uniform thickness, and a high degree of lightness. The sand of a hollow-ware foundry is to be fine, but it may be

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liberally mixed with coal-powder; blackening or anthracite may be used for dusting. The most elegant patterns are now manufactured into stoves, and we may say, that there is no nation where the art of constructing elegant and economical iron stoves and fire-grates, has been carried to so great an extent as in our country. The moulding of these patterns is simple, there are but few complicated forms, and therefore this branch is no particular object of our investigation. In the manufacture of hollow-ware, there is a great advantage in good well-finished patterns. If the patterns are perfect there is generally no difficulty found in making good castings, for most of the articles are thin, and there is little danger of the sand burning and adhering to the metal. Articles of commerce are generally worked to as much advantage as possible. Patterns of small articles, as parts of locks, latches, hinges, knife-blades, knife-covers, and other small articles, are generally put ten or twenty or more together, connected by a permanent channel which conducts the metal from the gits to the patterns, and forms a part of the pattern. Such a batch, or set of patterns, generally fills one flask. The New England States, and Pittsburgh, are remarkably successful in manufacturing small articles. In some cases various articles are put promiscuously

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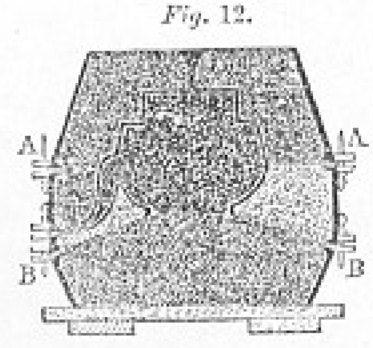
into one flask, in which, however, a similarity of size is to be observed. Whatever number of patterns there may be in one flask, it is always calculated to cast a flask of small objects with one ladleful of metal.

Moulding of a Coffee Kettle.—As an object to illus-

Fig. 12.



trate hollow moulding, we will choose the form of a common coffee pot, or water kettle, represented as moulded, in figure 12. The form of a water kettle is generally known. It is an almost spherical vessel, with a snout or pipe. We have selected one which fits to a cooking stove, with a contracted flat bottom; in other cases that bottom is round, with three studs to stand on. The pattern is here an exact model of the kettle as it is to be, with the exception of the pipe, which is, or may be solid. The flask consists of three boxes, of which the middle box is divided by a vertical division into two halves—cheeks. This divi-

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sion runs through the pipe and divides the mould into two halves, so that when both boxes are removed, the pipe, which is not fastened to the pattern, may be withdrawn. In this case the upper part of the pattern is divided just in the division of the middle box, which leaves an unsightly division, and is likely to expose the pattern to injury. A better plan of working is, to have the middle box in one piece, and divide at the lines A, A, and B, B. At the pipe the upper box reaches down into the middle box, as far as the pipe goes down, and divides the sand just along the bend of the pipe; the middle box parts with the lower at the rim of the kettle, where the core also separates, as indicated by the darker and lighter shades of sand in the drawing. The pattern is only divisible in the line A, A, through the pipe. In moulding this kettle the lower (in the drawing the upper) half is put on a board and the upper box rammed in, this box turned upside down and the other half of the pattern put on. The middle box is then set in its place, and fastened to the upper box. Both boxes may also be put together, and rammed in together, just as conveniently. Sand is then filled in the middle box around the pattern, and after this the sand is rammed inside of the kettle. The parting is made between the lower and middle box, as indi-

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cated, and the lower box filled. The flask stands now inverted, and the kettle on its bottom. The lower box—as the flask stands it is the upper box—is now withdrawn, then the middle box lifted and the upper half of the pattern withdrawn. First the middle and then the upper box put on again, and the flask turned, which will now stand as in the drawing. We may now draw the upper box, remove the lower part of the pattern, and put in the core for the pipe, which is made in a separate core-box. The git-pin is now drawn: this is very much tapered one way, and thin, the other way three or four inches wide, formed like a blunt wedge, whose edge is $\frac{1}{4}$ of an inch thick. The box is now put on again, and the mould ready for casting.

Patterns for hollow-ware require to be very accurate, if we expect the moulding to be well done. The originals of these patterns are generally moulded in loam, cast in brass, and turned in a turning lathe, or, if not of a round form, worked by other means until a perfect form is obtained. A pattern having been smoothed and polished, is then cut into such parts as are considered necessary to make it available. Pins, ears for handles, and studs for feet or handles, are generally put on loose. All dished utensils are generally cast with their mouth down-

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wards, except covers. Where the neck of a core is narrow, and there is any danger of the hot metal lifting the core, as may occur in the case of the coffee pot, the core is fastened to the bottom of the flask by a thin iron rod with a cross at the upper end, buried in the core and fastened below the bottom. Hollow-ware moulders need a variety of peculiarly shaped tools, and sleekers. Most of the tools are button-shaped, with short studs for handles, more or less round, or even cylindrical, to suit the various hollow forms of the patterns; others are plain and heart-shaped; others again have double plain surfaces at certain angles with each other, to suit certain corners in the mould. Blackening—plumbago—is chiefly used as dust, and if well polished, it will make smooth and good-looking castings.

In this kind of moulding, iron boxes are generally used; this is necessary to secure good and correct castings; it is also the cheapest way. If iron flasks are well made, the work in them is done fast, well, and safe, while imperfectly made or wooden flasks always cause more or less delay in work. From well made flasks many advantages may be derived: we will mention one. Suppose a moulder is to mould twenty flasks of one and the same pattern, if the boxes are well made and fit one upon the other pro-

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miscuously, there is no need of boards after the first drag-box is moulded. Upon the first box which is moulded, say the lower box, its complement the upper box is rammed in. After parting upon the upper box, the next lower box is moulded, leaving of course the pattern always in that box which serves as the bottom of the flask. In this way the top box of the first flask serves as the bottom to the next bottom box, and so on through the whole range of boxes. Each two boxes come together as they have been moulded, and it may happen in the course of the work, that one of the last boxes will not fit to one of the first, which however does not make any perceptible difference in the correctness of the castings. It requires some dexterity and experience to succeed well in this mode of moulding.

There are many articles here not enumerated as belonging to green-sand moulding; such as iron castings, parts of architecture, which are now so extensively used. To this belong window and door sills, door and window frames, columns and railing. All these forms are easily moulded, and require no particular details; we shall, however, mention some of them in the following chapters.

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Mixed Sand Moulding.—Moulding in green sand with dried cores may be considered a mixed moulding, which requires particular knowledge of the composition and construction of cores. In previous pages we have spoken of core-sand, but we shall here treat upon the formation of cores, and the quality of the core-sand for particular purposes. The management of cores is a matter which requires some ingenuity; malformation often causes perplexing failures, and is in most cases the source of unsound castings.

Cores are especially used in forming vacancies in castings, which cannot be successfully formed by the pattern. The forms of cores vary greatly, as may be expected; but in general, if made of open porous sand, free of vegetable and animal matter, and of coal, and if the sand does not contain too much clay, and the cores are properly dried, there is hardly any difficulty experienced on account of the cores. A caution not to be neglected is, that cores are never to be put into a green-sand mould until the very latest moment before casting. Cores which are not surrounded by metal on all sides, are made of stronger sand than others which are often not dried at all. In cores which are covered with metal on all sides, and have only one or

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two small vent-holes for the escape of the gases, as is the case with cores for narrow pipes, the sand is moderately mixed with free-sand. It is to have no more clay or adhesive matter than is just necessary to make it adhere for being moulded and dried. Sand of sharp grains, as pounded rock or slag, is more open than the composition of round grains, as river or sea-sand, and for this reason preferable. In many cases, yeast or meal water is used besides clay water to strengthen the core-sand, but these ought to be used cautiously, for not only water, but any other substance which generates gases is injurious to core-sand, causing blower holes in the castings. The safest core-sand is a natural sand which can be used without any artificial admixtures. Moulders ought to examine their neighbourhood until they find sand suited to their purpose, in case they are not already provided with it. Long or thin cores are stiffened by iron wires, or small rods of iron, which are moistened with clay water. Such wires or rods are buried in the core, and recovered when the casting is cleansed from its adhering sand. Cores of considerable length, also those in which the sand is rather strong, are pierced with long wires through the whole length, taking care not to drive the piercer through the surface of the core. Curved or angu-

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lar cores, which cannot be pierced, and are too long to do without vent-holes, are made open by laying one or more strings along the stiffening wire in the heart of the core, which strings are drawn out after the core is dry. If cores are too long to bear their own weight and the pressure of the metal, they are to be supported by chaplets or by staples. The latter are simply nails with broad flat heads; they are stuck into the sand mould, and project with their heads just so far as the thickness of the metal between the mould and the core is to be. Chaplets are simply bent pieces of sheet iron in the form of a [, or two pieces of sheet iron riveted to a pin, the distance between both being equal to the thickness of the

metal. Cores are covered with a coating of blackening, which is put on wet. This is the more necessary, as the cavities made by cores are mostly difficult of access, and an easy scaling off of the sand from the iron is therefore very desirable. Liquid blackening for cores is the same as that used in loam-moulding; and by referring to that chapter a receipt for its composition will be found. The blackening is laid on the wet core, as it leaves the core-box, by means of a heavy paint brush, and both the core and its blackening are dried simultaneously.

Small common cores are made in simple core-
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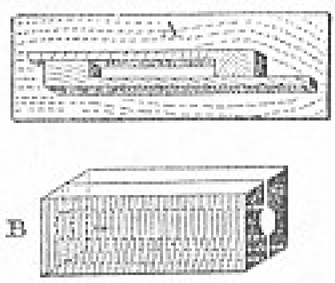
boxes, such as are represented in figure 13. A,

Fig. 13.



is two strips of boards, with a square projection on each end. Both are at liberty to be moved, and if laid upon a flat board, sand may be filled in the space which is formed by the squares: for each size, that is, section of core, such a box is required, but any length of core of that size may be made in a box of this kind. Round cores are made in boxes similar to that represented in fig. B. Globular cores are made in spherical cavities, and in fact any core in such a cavity as it is destined to form in the casting. Cores are not always made because they are necessary: they are frequently made to save expense in patterns and in moulding, and to render a successful cast more certain.

Moulding of a Column.—As an instance of mixed moulding, we will describe the moulding of a fluted column, which may serve as an illustration for most
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cases of this kind, particularly for pipes. Figure 14 represents the pattern of a column with orna-

Fig. 14.

mented capital, as it is imbedded in the sand, moulded, and ready for removal. A, A, are the core-prints, which leave a cavity to be filled by the long core which is to form the bore, or hollow in the column. It is in many cases difficult to mould a richly ornamented capital in green-sand, along with the trunk of the column, and still the capital ought to be in a solid connexion with the shaft; this case is here represented. On the pattern of the column, instead of the ornamented capital, a block of six or eight sides, or of more or less than that number, occupying the place of the cap, is inserted, as indicated by the lines in the drawing, and more distinctly represented in figure 15, by the dotted lines which represent a hexagon. The fluted shaft of the pattern is divided through the whole length into two halves, which is best done through the opposite channels, as indicated; for a seam which falls otherwise upon two ribs,
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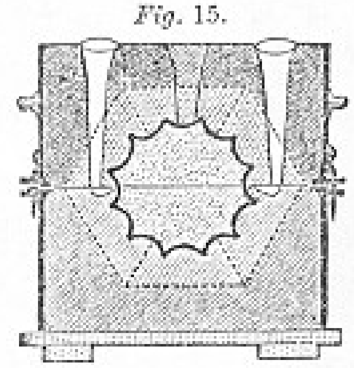
Fig. 15.



makes these ribs always more or less imperfect, which is not so glaring if it falls in the channels. Besides this division of the pattern, each half of the pattern is again divided into three subdivisions, or more, as the case may be. These latter divisions, as shown in the drawing, divide the circumference of the column into six parts, each half in three, held together by blocks and wood-screws. After the screws and the blocks are drawn, the pattern may be taken from the sand in parts, each part by itself. No second part is removed until the first impression is mended in the mould, in case there is anything broken in the sand. The capital is formed in the following manner.: If it consists of six equal ornaments, as leaves or spirals, one of these is carved, and prepared for being used as a pattern; over this pattern a core-box is made, and so calculated that a core made in this box will fill one of the parts of the
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polygon formed by the pattern. Such a core will fit in the mould, and occupy one part of the space having on one side the impressions of the ornaments

of the capital, joining with two sides the next cores, and resting with one side in the sand of the mould. The cores which belong to the upper box may have wires or rods inserted to be fastened with, to the box. After these cores are placed, the centre core is put down, the flask closed, and in fact managed like any other object of our consideration. In placing the cores, care is to be taken that the liquid metal cannot penetrate below a core and lift it; all the crevices which would lead to such a result are to be avoided, or carefully filled up with green-sand; and if there is any doubt as to the safety of the cores, they are to be wired down. At each end of the flask in the parting a small opening is left to communicate with the vent-holes of the core; these openings are in no way connected with the interior of the mould, so as to endanger the cast by admitting hot metal to run out this way. Gits and channels are as usual in the proper places, and if means permit it, the column ought to be cast inclined, into one gate which is at the lowest part, the git raised, by means of small boxes, to such a height as to balance the flow-gate. The latter is to be at the highest point of the pattern and

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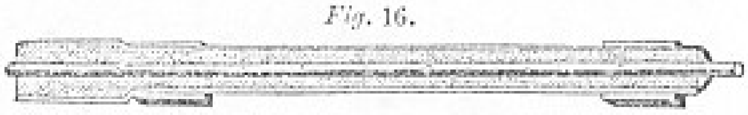
the box. Here, as in any other case, the cast-gate is to be kept full, in pouring in the metal, to prevent the running in of impurities along with the iron. Directly after the column is cast, or better still while the metal is pouring in, fire is to be applied at both ends to kindle the gases escaping from the core, which gases will explode if left to kindle spontaneously.

Water pipes, gas pipes, or pipes for any purpose whatever, are moulded in the same manner as columns. There is no essential difference, but in the form of the pattern. The core of a pipe is to be a fac simile of the bore or hole to be formed. A core-box for water or gas pipes is represented in figure 16: it shows a

Fig. 16.



longitudinal section of an iron core-box. Frequently such boxes are made of wood; but in well conducted establishments they are made of cast iron. Wood is apt to twist and warp, and in consequence causes imperfect cores. An iron core-box is generally round, about half an inch thick in metal, and has two square projections to rest upon when laid down; around these projections an iron strap is drawn, to hold both halves together when in use. A core-box

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is to be true in its bore, for which reason it is bored or planed, so as to make it true. Both edges, where the halves of the box join, are, if not quite sharp, to form a blunt edge in case the core is made when lying in a horizontal position. To make good cores in a lying box requires a great deal of experience, and it is for this reason not generally practised. In most cases the box is rammed-in vertical or inclined; the latter way is more convenient than the first, and quite as good. The ramming-in of the sand is done by a long iron ramrod. The centre of the core is, in very thin cores, say $1\frac{1}{2}$ inch diameter, an iron rod, along which a wire is laid; both are rammed in together, and the wire is withdrawn while the core is in the box. This leaves a cylindrical channel all through the core, and serves for the escape of the gases. In thicker cores, of two or three and more inches in diameter, the centre rod is a hollow pipe of cast or wrought iron, full of holes. The latter are necessary, or the gas would not find its way to the interior of the pipe. Heavy cores are made of loam, of which we shall speak in another place. The centre rod is to be a few inches on each end longer than the core. This forms the bearing for the core to rest upon when it is to be dried, and

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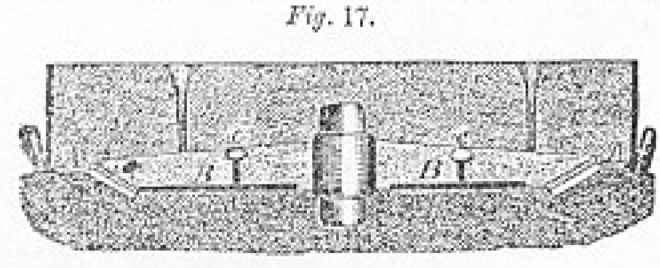
also the journal on which it is to be turned, when the blackening is to be laid on.

Moulding with Plates.—In many cases cast-iron plates with handles are used when one part of the mould is to be removed before the pattern can be drawn. This is the case with the sand between the arms of a bevelled wheel; also with face wheels, or in cases where the pattern, and consequently the sand, is too deep to admit the drawing of the pattern without injury to the mould. Plate moulding is generally performed on bed-plates of steam engines, bedplates of turning lathes, house props, and in all cases where the sand is surrounded on three sides by hot

Fig. 17.



metal. The sand lifted out in these instances is dried and treated like a core. In the case of a bevelled wheel the moulding by plates is effected as follows: Figure 17 shows a section of a bevelled wheel as it is imbedded in the floor of the foundry, which has been levelled for the purpose. The sand, in immediate contact with the pattern, is sifted. The parting

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is in the line A, A. In the spaces between the spokes, cast-iron plates, B, B, are inserted, with wrought-iron handles cast into them: these plates are cast in open sand, and from $\frac{1}{2}$ to $\frac{3}{4}$ of an inch thick. They have in this case a triangular form, similar to the space they serve to occupy, and are at least two inches all round, smaller than that space. These plates are laid upon the parting, or, in many instances, impressed into the sand about $\frac{1}{4}$ of an inch deep. They are then covered over with a layer of small iron rods, or wire, or in many cases wooden rods, dipped in clay-water. These rods overhang the plate and reach near to the pattern. The body of sand in the centre of the plate will sustain that end of the rod which is to carry the sand beyond the plate. The space between the arms is then filled upon the plates with moulding sand, flush with the pattern. This forms the parting for the box. After the pattern is covered, and the top box removed, the sand between the arms is removed, by means of the handle C; of which there may be more than one if the core to be lifted is too heavy for one hand, or it is to be lifted by the crane. This part of the mould forms separate pieces: cores in the form of triangles, which may be blackened and dried. The pattern being removed and the other parts of the mould

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ready for casting, the plates are replaced, either green or dried, just as convenient. The upper box is put on, and the mould may be filled with metal. This kind of moulding is very extensively used; it is a cheap and very convenient way of working.

Dry-Sand Moulding.—This is a very interesting branch of moulding; to it belong most of the brass and bronze moulding, ornamental iron moulding, and a great part of machine moulding. Dry-sand moulding is in many respects preferable to loam-moulding; it gives a casting more true to the pattern than loam, which latter, on account of its shrinkage, frequently gives imperfect forms to the cast. The strength and uniform texture of the castings is quite as well secured in dry-sand moulds as in loam moulds. Dried or baked sand often consists of a mixture of loam which has been used, and fresh sand; in most cases, however, particularly in ornamental moulding, fresh sand is used. Dry-sand obtains a very firm and open texture, and is well qualified to cast machine shafts, pipes, and such articles as require strength and beauty. The manipulation of moulding in dry-sand is exactly the same as in green-sand, but is less difficult. In this case no coal powder is mixed with the sand, which leaves the sand stronger. If fresh sand is used, it is of very easy moulding. When

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the moulds are finished and blackened, they are conveyed to the drying stoves, for at least twelve hours, twenty-four hours, is better to expel by the action of heat the moisture contained in the damp sand. The blackening is done by a paint brush, in the humid way, just as loam moulds or cores are blackened. This is done with some caution, so as not to injure the sharp outlines of the mould. The blackening is applied very thin. A moulder who understands mixing his sand properly, so as to be strong and porous, and assume at the same time fine impressions, will make finer castings in this way than can be done in any other mode of moulding. Dry-sand moulding requires strong iron boxes; wood is impracticable, for even if it did not burn in drying the mould, its warping and twisting would injure the mould. All the traverses, if any are needed, are to be of iron. Long patterns, as shafts, require particularly strong boxes, for these are mostly cast in a vertical, or at least in an inclined position. The pressure upon sand and boxes is then very heavy. Hooks and eyes are in these cases not strong enough to hold the boxes together; it requires *glands* to accomplish this. Glands are double angles, made of flat wrought iron. The rods are to be six inches longer than the height of the flask, or of the two boxes together: these six inches are for

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bending a square angle at each end of the rod, after which it assumes the form of a [. The distance between the angular ends is to be a little greater than the height of the boxes and bottom. In slanting these glands upon the boxes, the flask may be drawn together as tight as the strength of the glands will

permit. The drawing of the glands is performed by small crow-bars gently, so as not to injure the mould. We shall speak of this hereafter. Boxes for dry-sand moulding, if heavy, are to be provided with swivels on each end, for each box is to be turned, the facing of the mould uppermost; blackening and drying require this. In moulding pipes, which need strength, it is necessary to mould them in dry sand, in strong boxes, and to cast them vertically, or at least inclined 30° or 40°. Pipes, or any other objects which are cast horizontal, have always one bad side. The upper side is in most cases porous, unsound, and, in pipes, generally thinner than the bottom side. The liquid metal is apt to lift the core, in spite of staples or chaplets. Another advantage arises from casting vertically, in the better escape of the gas, and the greater security of the core against injury. The core is not so liable to bend and the core-rods may be lighter.

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Moulding of a Large Pipe.—There is not the slightest difference between moulding in dry-sand, and moulding in green-sand, except in the composition of the sand, blackening, and drying of the mould; and therefore it hardly seems necessary to illustrate this branch. We will, however, describe the moulding of a large water pipe, as illustrative of this case, and introductory to loam moulding. All water pipes of more than twelve inches diameter, ought to be moulded in dry-sand, and with loam cores. Water pipes are generally made from eight to nine feet long—small pipes frequently but five or six feet long. The pattern is like the exterior of the pipes as it is to be when cast, having at each end a core print five or six inches long. The pattern may be of a solid piece of wood, but is generally composed of strips of plank, to diminish the weight of it; it is divided parallel with its axis, into two halves. After the moulding is performed in the usual way, the mould is blackened and carried to the drying-stove, on an iron tram-road, or by means of a crane. If the foundry possesses no drying stove, or if the boxes are too heavy for transport, some boxes may be put together, a temporary wall of bricks or moulding boxes set around it, covered with sheet iron, and a fire of coke or charcoal or anthracite is kindled

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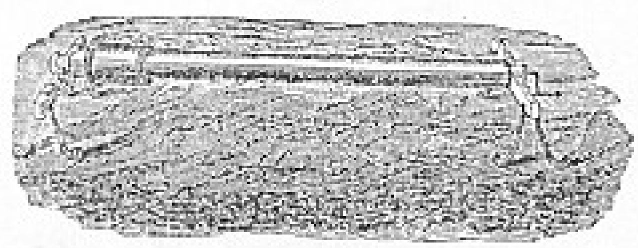
below. The boxes are dried in this way on the floor of the foundry. This mode of drying moulds, however, is imperfect, and slow, produces inconvenience in the foundry, and is expensive. The making of a loam core is a matter of no difficulty, if core-bars, loam-board, and loam are in good condition. The core-bar is in this case a hollow, cast-iron, cylindrical pipe, perforated all over its surface, with either round or oblong holes. The core-bar is about three inches less in diameter than the core is to be, with a view to provide room for a hay or straw rope, by which the core is made porous, and so thick as to leave just sufficient space for loam. The core-iron has a journal at each end, made of wrought iron and screwed to the cast pipe, leaving as much opening as possible for the escape of the gases. These bearings, or journals, may be of cast iron, in which case they are made hollow and square inside, to receive a winch by which the core-bar is made to turn upon

Fig. 18.



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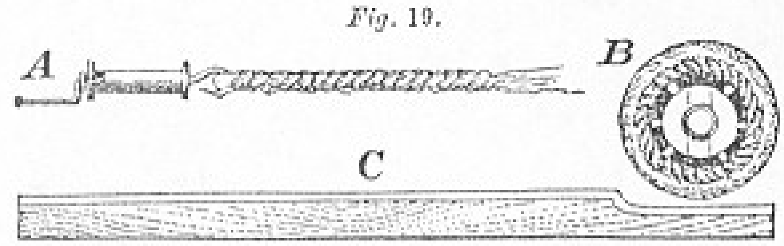
its axis. The bar with its bearings is laid upon two iron trestles, as represented in figure 18, on which it may be turned to receive its hay rope and loam. The trestles are about three or four feet long, and are provided with various sized triangular dentations for different-sized journals. The hay or straw for ropes is kept in a moist place, to have it soft and more fit for being twisted. To make a hay rope, a simple winch, made of quarter inch iron rod, with a wooden handle, is required, such as is represented in figure 19, A. Hay ropes are made by the boys when not

Fig. 19.



otherwise engaged, and kept for use when required. The method in which the rope is applied is simple: the core-bar is laid with its journals in the trestles, as shown in figure 18, the rope fastened at one end, and the bar turned upon its axis; the rope is led

so as to make a close and tight covering. If the rope is loose on the spindle, it is liable to be pressed together by the fluid metal, which would, in the most favourable case, injure the casting, but would
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almost invariably cause a failure of the cast. Wooden core-bars are not to be recommended, as it requires something stronger than wood to resist the pressure of a high column of fluid metal. In figure 19, B represents the cross section of a core, in which the core-iron, journal, hay rope, and loam covering are shown. The hay rope receives a slight covering of thin loam, just sufficient to cover the hay, and remove the roughness of the rope. This coating of loam being dried, the core is taken again in the trusses and the loam-board is applied. The loam-board is, in this case, an almost straight board, of eight or ten inches wide. It is straight every way, and to prevent its bending while in use, it is supported by a rib, screwed to it, or by a strong plank, upon which it rests. The board is so long as to rest upon both trusses, and is fastened to these, just so far from the centre of the core-iron, as to form half the diameter of the finished core. The edge of the board (in the drawing, the upper edge) is shaped as the form of the core, which is in this case almost a straight line, but is cut out, at one end, to form the funnel, or cup-mouth, of the pipe. When the board is in its proper position, and fastened at both extremities by means of weights or screws, it is obvious that when the core-
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bar is turned upon its axis, it will describe the form of the core along the edge of the board. By turning the core-bar with its hay rope and superficial coating of loam, and throwing on additional moist loam, the surplus moist loam will be stricken off by the loam-board, or laid on in those places where the board does not reach the loam. When the core is properly filled up and closely covered with loam, the loam-board is taken away, washed, and put in its place again. The core is now turned somewhat faster than before, and receives a slight washing, merely by dipping the hands into water, and moving them over the surface of the rotary core. When smoothed, which is done with as little water as possible, the core is brought to the stove and dried, then blackened, dried again, and is then ready to be put in the mould. If the cores are long and limber, the staples are not to be forgotten.

The thickness of the covering of loam depends partly on the quality of the loam, but chiefly on the thickness of the metal, and the duration and amount of pressure upon the core by the fluid metal. For common water pipes, if cast inclined, and porous loam is used, one inch is sufficient for the core, but, if cast standing, one inch and a half of loam ought to cover the hay-rope. If the thickness of loam on a
92
core be more than three-quarters of an inch, it is necessary to lay on the loam in two or more layers, always drying the first layer before the next is put on. The loam which forms the core is made as open as possible in its composition; old moulding-sand, old core-sand, or river-sand is mixed with the loam. The working edge of the loam-board is not a square, but is slanted so as to form an angle of nearly 45° to the tangent of the periphery of the core. This is necessary in order to make the board to sleek (to make the loam smooth). A square edge would cause a rough surface to the core. The slanting of the edge is indicated in figure 19, C, at one end of the board.

After careful drying, blackening, and polishing, the core may be put into the mould, if required. The mould is provided with staples so as to support the core, and is then carefully closed. If the box, or the pipe, is large, it is advisable to cover the box by a strong board, and put the glands upon the board, so that there is a board at top and bottom of the flask, to protect the sand from being pushed out. In many instances the moulding boxes are tapered so as to form half a hexagon; in these cases glands are of no use, and heavy iron weights which reach all across the boxes, are used to bear the top-box
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down. Air-holes at both ends of the box are to be provided for, for the core in this case emits a great deal of combustible gas, which is to be kindled in proper time to prevent explosion.

Pipe moulding is a very common employment in iron foundries, but still there is something peculiar in it, which makes it inconvenient to cast pipes in a foundry where green-sand or dry-sand moulding is done at the same time. It suits best in a loam-mould-

ing establishment. There are great varieties in the form of pipes, but as long as they are straight, a pattern is made and moulded in dry or green sand. The core in this case being also straight, is easily made. It is more difficult to form the core for a bent pipe or knee. We will allude to this in the next chapter.

Casting Pipes without Cores.—There was considerable interest manifested, some time ago, in a process for casting pipes without cores, by means of machinery. An iron mould, well bored and polished, is made to turn upon its axis in a horizontal position; the fluid metal cast in at one end, will naturally flow round in the mould, and if sufficiently fluid, will make a pipe of uniform thickness. How this machine turned out in practice, we do not know, for nothing has been said about it for a long time. Any improve-

ment which will reduce the price of iron water pipes is worthy of notice, and the above machine ought to attract sufficient attention to give it a fair trial. One thing is certain, that every kind of pig-iron is unsuitable for this process.

Moulding of Fine Castings.—Before we conclude this chapter we will give a short description of ornamental moulding; that is, the moulding of small ornaments and trinkets in iron or bronze. There is little difference between moulding for iron, and moulding for bronze; the chief distinction is in the thickness of the cast. Bronze must be cast very thin, if sharp, fine, and distinct outlines are desired. In iron, the same attention need not be paid to the weight of the cast. The principal thing to be attended to in moulding small articles, is the quality of the moulding-sand. This must be as fine as it possibly can be obtained. It ought to have as little clay, or any other foreign admixture, as possible, to prevent its shrinking, and in consequence breaking and cracking. Sand for this purpose is to be an almost pure silicious compound. Coal-powder or any other admixture is inadmissible; it is fatal to the beauty of the cast. Good sand of this kind adheres easily with the least amount of water, takes the finest impressions of the skin, and may be cut into fine slices by a

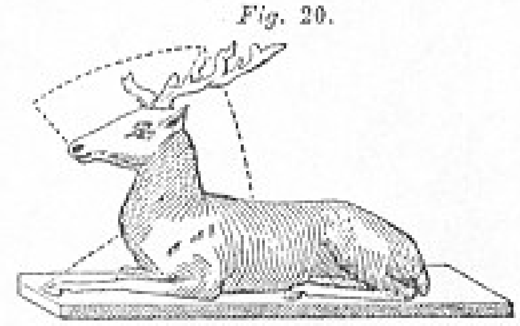
sharp knife. For this kind of work, the greatest evil is too much clay in the sand; other impurities can be removed by sieves, or by washing. Fine tripoli is the best sand for these purposes.

Small articles of bronze or iron, are moulded in the same manner as larger parts of machinery, or hollow-ware. The sand is rammed very close in small iron moulding-boxes, and the boxes dried in the stove, blackened if for iron, but not so if for bronze or brass. For brass or bronze it is advisable to face the mould each time with fresh sand, thrown on through a fine silk sieve. If this coating is but one-twelfth or one-eighth of an inch thick, it improves the casting considerably. Moulds for iron cannot be dusted with charcoal, or black lead, as these would be too coarse. The moulds after they are dry are blackened by a rush-candle, or the black smoke from a pine knot. The box which contains the mould is inverted, so as to turn the face of the mould downwards, rested upon two extreme points. The flame of the candle or wood is held under the mould, which will assume in consequence a velvety coating of fine carbon. There is to be as little blackening as possible; too much will injure the mould and the casting. To mould a simple rosette, or anything which gives but a simple impression in the lower and upper box,

is of very easy performance. The case is different with more complicated forms—articles which cannot be screwed together, but must be cast in one piece, as statues, columns, and other similar objects. This is an interesting art, and it may be of some use to illustrate a few cases of this kind.

Moulding of a Stag.—If the small form of a stag, figure 20, resting upon a platform, is to be moulded,

Fig. 20.



it is at once visible that the antlers cannot well be brought into the same mould with the body: they are moulded by themselves, and screwed on. The platform can be cast with the body, but it makes less work in moulding to cast them separate, and screw the platform also to the body. We have now only

the body of the animal left to make a mould for. In this case the natural parting is over the back, following the spine, and so dividing the face and breast. The pattern is accordingly cut in two in

this line. When one half of the pattern is moulded, the box is turned up, and so much of the sand as cannot be lifted, is cut out around that half of the pattern; this forms the parting of the boxes. The surface of the parting is well polished, some parting-sand thrown on, and the other half of the pattern set upon the first. Cores are now to be provided in those places where the upper box will not lift. We find that a core is to be made between the two fore-legs, as indicated by the dotted line. Another core is needed on the face, from the nose to the ears; and a third core, joining the second at the ears, running down its neck. This will be all the cores needed, for the other parts of the pattern divide naturally. These cores are made of fresh sand, even if the other mould is made of old sand. Old sand will not stand the necessary moving of these cores. The cores are often moulded upon fine blotting or oiled tissue paper, if small; but if the cores are large, wire is to be buried in them. When the upper box is filled with sand, which is done after the cores are well finished and parting-sand put on, the upper box is lifted, one half of the pattern removed, and the flask closed again. The flask is now inverted, the lower box lifted, and the other half of the pattern removed. The same manipulation, in principle,

is used in moulding a grooved pulley. By this mode of moulding, the cores are not removed. This is only practicable where the pattern can be and is divided, and where it is of light material. If the pattern is heavy, made of metal, and it cannot be divided, then the cores are to be drawn back from it as soon as the upper box has been lifted. There is no need of moving the cores further than is just necessary to have them out of the way for lifting the pattern. Good parting-sand is sufficient to separate cores so large as to take wire. Very small cores are best bedded upon paper; in pulling the paper, the core resting upon it will follow. As soon as the pattern is removed from the sand, the cores are again put in their places, and the boxes removed to the drying-stove for drying. It is a matter of precaution to fasten the cores, if they are once in their places, with hooks of thin iron wire, bent at one end, and pin the cores to the mould. There is less danger of injury happening to the mould, in handling the boxes, if the cores are secured in this manner. When the mould is properly dried, which may be done within twelve hours (though a longer time would be preferable), it is joined together, glands or screws put on, as the case may be, and cast. If the article is to be cast in bronze, brass, or any other metal

besides iron, it is not blackened; but if it is to be cast in iron, it is blackened as before described. There will be no difficulty in casting the antlers to this pattern: the platform also is very simple. Moulders who are skilled in this kind of work, will mould two loose cores, one upon the other, but in most cases it is preferable to dry one part of the mould with its cores, and then put on the other cores; in both cases, however, it requires experience to handle such tender, brittle things, as small sand cores, often but one-eighth of an inch thick, and half an inch in area.

Ornamental compositions are screwed together, to form an ornament of many parts. Small ornaments are soldered together, or riveted and soldered. Solder for iron trinkets is a fluid composition of a little silver and gold. The soldering is performed by the blow-pipe. Solder for brass and bronze is the same, if the articles are to be gilded; in ordinary cases, brass or tin solder is used.

Brass ornaments are mostly cast hollow; this is not so much for reasons of economy, as with a view of making more perfect castings, and saving labour in chipping and chiselling. As no coal can be used to protect the metal against burning together with the sand, it is necessary to cool it as quick as possi-

ble, and in this way give it a smooth surface. The making of cores in these instances is often connected with considerable difficulties. The cores of complicated figures are composed of parts, that is, a core-box is made for one part of the core, and the parts cemented together to form the core. Iron castings are but seldom cast hollow, if small, that is, articles of less than six or eight inches extent; larger figures

in iron are cast hollow, for if the body of hot iron is large, it will burn the sand, or melt together with it. Fluid iron, suitable for small castings, and the use of good fine sand, will make ornaments finer and sharper in expression than castings in any other metal. Horse-hair and cotton thread may be imitated to perfection. The wings of a fly with its microscopic nerves may be copied in iron; and green leaves stiffened so as to be applicable as patterns, may be cast in iron without difficulty.

Loam-Moulding.—This is the most ancient branch of moulding. In this department the moulder is his own pattern maker. He furnishes in most cases the pattern, and makes the mould also. In some instances a pattern, or parts of a pattern, are made of wood, and buried in the loam, but these cases do not happen frequently. The loam-moulder will furnish patterns with great ease, which cannot

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be made well or so cheaply in any other way. Any form of a pattern, or any casting of whatever kind, may be done in loam. In practice, loam-moulding is generally restricted to forms which cannot be cast conveniently in any other way. Loam-moulding is more expensive, generally speaking, than any other kind of moulding, except in cases of simple forms and heavy castings.

Every piece of loam-moulding is a regularly constructed edifice. No moulding in loam for a casting of importance, is commenced until a perfect plan of the whole operation from beginning to end is laid down. If no such plan is made, it may happen, and frequently does happen, to be impracticable to mould in the way commenced, whereby often the labour spent so far, is lost. The most important part of this branch of moulding, is the composition of the loam employed; it demands the strictest attention, and is varied according to the objects to be moulded, as loam suitable in one case will not answer in another. Fineness and porosity, and as little shrinkage in being dried as possible, are indispensable qualities. The mould must be dried hard, to resist the pressure of the fluid metal, which will otherwise break it or crumble it to dust, and spoil the casting. If loam is too

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close, or imporous, it will retain the gases developed by the heat of the metal, and cause either the metal to boil and make porous castings, or in the worst case cause explosion, and throw out the hot metal. If loam shrinks too much in drying, it will inevitably crack, make crevices into which the hot metal runs, and what is still worse, some parts of the facing of the mould will be pressed back, which causes uneven, rugged castings. The most important quality of loam is its porosity. The heat of the cast, and the presence of gas-generating material in every part of the mould, renders it necessary that the gases should escape through the substance of the mould, while it is impervious to the metal. There is no use in piercing holes by the pricker; if the loam is too strong, the cast will boil.

Moulding-loam is generally artificially composed of common brick-clay, and sharp-sand. Instead of the latter, old coarse foundry sand, or used core-sand, or burnt brick-powder, may be used to greater advantage. The quantity of sand to be mixed with the clay can only be known by experience. It is impossible to give receipts for compositions, because the quality of loam as well as that of the sand is variable, and differs in every instance. For heavy, thick castings, the loam is to be stronger than for small or thin castings.

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Cow-hair obtained from tanneries is used to prevent the cracking of loam and make it porous. Mill-seeds, sawdust, horse-dung, hacked-hay or straw, are still more extensively used than cow-hair. Loam is to be worked diligently, to make its texture as uniform as possible. The matter to be mixed with it is to be distributed equally through the whole mass. Each part of the mould requires a different kind of loam: one for the facing of the mould, and another for the body; a stronger loam for brick-work, and a weaker one, with more straw or horse-dung, for a common mould. Parts of a mould which are almost surrounded by the pattern, and of course by the metal, are to be burned in a fire almost to a red heat, not only to expel water, but also to destroy everything which could generate gas, and to destroy every particle of vegetable and animal matter. This operation is necessary to be performed on all cores, and such parts of a mould as form the interior of it. The gases generated in a loam mould are of a complex nature; there are gases of water—steam—carbonic acid, carbonic oxide, and ammoniacal compositions

which are not determined. The flame issuing from a loam mould, generally burns with a blue light, interspersed with greenish yellow streaks and specks.

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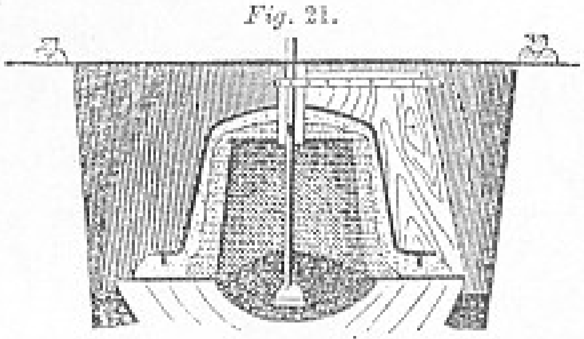
Moulding of Simple Round Forms.—Articles of a round form, that is, a spheroid, or a segment of it, a cylinder and its auxiliaries, are moulded by means of a loam-board fastened to an iron spindle, which may be turned upon an imaginary axis, or the axis of the spindle. Wherever a loam-mould is built up, it must be always in the sweep of a crane, or it is to be built in that pit where it is finally to be cast. We will commence our illustration by the moulding of a soap-kettle in the pit. A soap-kettle—or soap-pan—is generally partly cylindrical, with a round bottom, broad brim, and a collar, for the wooden superstructure of planks to be set into it. All kettles are moulded and cast in an inverted position, as is shown in figure 21. It would be better for the quality of the cast if kettles could be cast bottom down, but this is almost impossible on account of the core. The moulding of a kettle is represented in figure 21.

Fig. 21.



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It is here performed, for want of a crane in the pit, on the very place where it is to be cast. A hole is dug in the floor of the foundry sufficiently deep to bury the whole mould, and wide enough to permit the moulder to walk around the mould when he is at work. The first thing to be done is to cast a round plate or ring in open sand. This is to reach at least six inches into the kettle: that is, its smallest diameter is to be twelve inches smaller than the shorter or interior diameter of the kettle, and its largest diameter is to be from eight to twelve inches longer than the longest diameter of the pattern. This plate may be three-quarters of an inch or one inch thick. It is placed in a perfectly level position on the bottom of the pit, and raised by bricks to the height of six or eight inches from the bottom. In the centre of this ring-plate a pole or piece of cast iron is driven in the ground, and covered by sand to protect it against heat. In this pole a pan, or step, is cut for the pivot of the spindle to move in. A spindle of one and a half or two inches square wrought iron, having a round bearing at its upper end, and a steel point at its lower extremity, is now erected; resting below in the centre step, and above in a plank laid across the pit, borne down and held in its place by weights placed upon it at the extremities. This

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spindle is to stand perfectly plumb, being exactly in the centre of the foundation plate. To this spindle a moveable arm is screwed, made of two rods of flat iron, with many holes in it. At the spindle these two flat bars are bent in such a manner as to catch two corners of the spindle, and be immoveably fastened to it by two screws. In other cases a cast-iron forked arm is made with holes for screwing on the loam-board, and a spindle-box with pinching-screw for adjustment. To this arm the loam-board is screwed, which is an inch thick pine board, clear of knots. The loam-board is at first a skeleton of the interior of the kettle with the brim, and that slanting part beyond the brim, called the knee; if turned upon the axis of the spindle, it will describe the form and size of the interior of the kettle. In commencing the mould, a four inch brick wall is built upon the foundation plate, or platform, round, so as to leave two inches space between it and the loam-board. At the height of six inches below the corner of the bottom, a layer of one and a half inch iron bars is laid, and these are crossed by smaller bars, all walled-in in the brick work. Upon these bars the bricks forming the crown are founded. If the bottom is round, forms half a sphere, these iron bars are not needed; an arch may be sprung of bricks,

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which generally is strong enough to resist the pressure of the fluid metal. The moulder leaves a small opening around the spindle, serving the purpose of a drafthole for the fire which is to be kindled inside. This first brick wall is dried by a stone coal or charcoal fire, kindled inside below the mould. The loam-mortar for putting up the wall, is to be porous, but also strong; some horse-dung is generally mixed with it. It is composed mostly of sand, and the layers of mortar are from half an inch to one inch

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thick. The bricks used for this purpose are hard-burnt, light, but such as have not been melted, or burned too hard. Bricks are used in halves or bats. While the brick wall is drying, a thin layer of loam may be given to the mould, which here constitutes the core, in case the work is pressing; but if there is time, it is better to dry the bricks first. The loam may after this be increased to within a quarter of an inch to the loam-board, still keeping up the fire, and drying the core gradually. The last layer of loam is put on when the first loam-coating is nearly dry. It consists of finer and stronger loam. It is free from horse-dung, straw, or any other admixture, but is mixed with some cow-hair. The surface is finished off by a smooth coating of wet fine loam, the redundancies being swept

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off by the loam-board, which has been washed and freed of all adherent loam and straw. As the surface gradually dries, it is painted over, by means of a paint-brush, with a mixture of charcoal-powder, clay, and water. This coating forms the parting between the core and the metal-thickness.

The loam-board with which the core has been formed is now removed, and is replaced by another board, called the thickness board. The edge of the thickness board describes the external form of the kettle, and merely touches the knee made by the first board. We see here the use of the knee: it serves not only for the more perfect closing of the mould below, but it is the standard mark of the loam-boards. Over the nearly dry core a layer of porous sandy loam is now spread, and made smooth by sweeping the thickness board around it. This layer of loam forms the exact pattern of the kettle as it will be after casting. When well dried, this layer of loam receives a blackwash as the core did, and is to be well dried. The spindle may now be removed, for there is no more use for it in this instance. Over the first foundation plate, or platform, is now laid another platform, whose interior diameter is equal to the diameter of the knee, so that this ring when laid down just fits, or is a little larger than

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the largest part of the core. Upon this platform another layer of loam of nearly two inches thick is laid, and smoothed over by hand. There is no need of a smooth surface. As long as the loam continues soft, the mould is kept under bars of iron bent in the shape of the bottom, or crown of the mould, and reaching down to the platform, to which they attach themselves by being bent under the platform. Two or three of such bars reach all over the kettle, others may be shorter and reach merely along the sides. These bars are laid over the soft loam, and then the mould is gradually dried. When nearly dry, iron hoops, which keep together the rods, are laid around the mould, and fastened to the rods by means of wire. The whole mould, iron and all, receives after this a good coating of straw loam, with horse-dung, the iron bars being partly covered with it. In this manner, iron and loam are combined and form one solid part of the mould. The structure of the mould is now completed, so far as the form is concerned. The whole is now thoroughly dried or baked by keeping up a constant fire in the interior of the mould. Fire may be applied on the outside also. In this instance, which is that of moulding a kettle with an open core, not so much fire is required as if the core was solid. In the latter case

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it requires a thorough burning; the core is then to be made red hot; but in this instance a good drying is sufficient to secure a safe cast. In twenty-four hours the mould will be found to be dry, and ready to be taken apart.

The taking apart of the mould is done by means of a crane, in case there is one; otherwise it is to be done by hand, by a pulley, or by some other means which are sufficient to lift the cape or cope. The first step to be taken is to lift, by means of a sharp crow-bar, the platform of the cope from the platform of the core, that is, to loosen the first from the latter part, after which it may be lifted and set upon a pair of timbers over the pit, or on any other convenient place where it is not exposed to moisture. When the cope is removed, the "thickness" is peeled off from the core, the draft-hole in the crown is closed by a brick-bat and plastered over with loam. The hole in the centre of the cope is also filled up to within two inches, all the damages on the mould repaired, and these patches dried. After this the mould receives a blackwashing, and is then finally dried once more.

Blackwash.—The blackwash for parting consists chiefly of charcoal-powder, and a little clay. This is almost entirely lost in taking the mould apart,

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and the remainder is lost in sleeking the mould by the finishing clay-wash. Blackwash is always on hand in the foundry; it is contained in the blackwash tubs, of which there is one for parting and one for finishing. The latter is composed of finely ground plumbago, often mixed with a little charcoal, the whole diluted with horse-dung water, or a solution of the soluble parts of horse-dung. This blackwash is frequently mixed with pease-meal or other meal, glue, and extracts from the refuse of tanneries; but all these latter compositions are more or less too close, and cause a dull surface to the cast. The first is the best, if applied not too much diluted.

The sleek-washing as well as blackwashing is to be done with proper caution, so as not to injure the sharp outlines of the mould; it is better if the first of these two operations can be dispensed with, and the mould finished just as the loam-board left it. This latter can be done in following the plan to be described in cylinder forming, which is also applicable in this case; that is, working without thicknesses. When the parts of the mould are properly dried, it is put together again; but before this is done, a hole of two inches round is cut in the brim of the cope, to connect the gates with, for casting. The cope is to rest firmly upon the core, that is, it

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is to be put exactly in that position in which it was before, and shut tightly at the knee. A pipe is now laid below the foundation of the mould, which pipe is to be carried through the sand which is subsequently rammed in, to conduct the gas from the interior of the core to the surface. This pipe may be either an iron pipe, or may be of baked clay, or it may be a space left in the sand. The latter is objectionable, because it may fill up, and cause an explosion by stopping the escape of the gas. The mould is now rammed in with sand, which is done by iron stampers with strokes in rapid succession. This operation is performed by at least three hands at once, to break the vibrations caused by stamping, and prevent injury to the mould in consequence. With the ramming-in of the mould, the gate for the reception of the metal is to be provided for. This we contemplate to be in the lower part of the mould; it is frequently done from the top, but the latter mode is not quite safe, and never makes as sound castings as the way proposed here. The gate may be formed by a wooden pattern or pin, as in green-sand moulding, but this is at best a very doubtful operation in its consequences; for the gate will be a long one in all cases, and in pulling out the pin, sand may drop in the gate and stop it up altogether, or drop so

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much sand as to injure the casting. The best plan is to have pipes ready made of burned loam; such pipes may be conical, and tapered so that the smaller end of one pipe will fit in the larger end of another. In this way any length of gate may be formed, perfectly secure against damages from stamping. On the top of the mould a flow-gate is set, which may be also formed of one of burned loam-pipes, or it may be moulded in the sand. The first plan, however, is preferable. The whole space around the mould is in this way filled up with sand, and tightly rammed. Over this sand, that is, over the mould covered by the sand, pieces of pig-iron or other heavy pieces of iron are laid, or iron beams tied down by screws which reach to the platform, and are fastened to the latter, to prevent the least motion of the mould upwards, for such a motion would spoil the mould. Before casting, the flow-gate is covered with a dry ball of loam, to be removed when the fluid metal shows itself in the gate and the mould is filled with iron. Over that channel or pipe, communicating with the interior of the core, a handful of dry wood shavings, or dry straw, is laid, and kindled as soon as the hot metal is being poured in.

The stopping up of the flow-gate is a necessary operation, and the flow-gate itself also is necessary

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in all cases of large castings. The flow-gate is very useful, because it is always put on the highest point, or at a point to which most of the light impurities which float on the melted metal are very apt to flow. If the flow-gate is placed in such a situation, the impurities will naturally flow into it. For these reasons the flow-gate is always made wider than the cast-gate. The stopping of the flow-gate until the metal appears, is an operation equally important. If

the flow-gate, or any other aperture to the interior of the mould, is open, the gases or hot air will rush to the opening with a force equal to the space of the mould and the amount of hot metal to be poured into it. This rush of air is very apt to tear loose some loam or sand of the mould, or even break the mould. By stopping the openings, a certain amount of confined gas finds its way through the sand or loam of the mould, and opens the pores of the mould. This stopping up of the air channels is the safest way of preventing explosions and making good castings. In case there is no flow-gate to a mould, and only a cast-gate, the latter is to be kept full all the time during which metal is poured in. If there is an interruption of the flow, and the rush of air finds its way through the cast-gate, it is very apt to cool the metal, tear some sand loose, and by that means stop up the gate,

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or even break the mould. Such accidents happen frequently, and are the common causes of failure in founding. When castings are made by a single cast-gate, it is advisable to make a reservoir for the fluid metal at the top, that is, to make the mouth of the gate very wide, and skim the metal well to prevent the flowing in of any impurities. In moulding hollow-ware, the wedge-shaped gits are made partly for causing an easy separation of the git from the cast, but chiefly to have a git of large capacity and small opening, to be kept full while casting.

Gas Pipes.—The air pipes leading from the core of a heavy casting ought to be made of iron, for these pipes have an important office to perform. In case such a pipe is stopped up, an explosion is almost inevitable. The atmospheric air confined in the hollow space of the core, and that air contained in the pores of the sand, mixed with the carbonic oxide gas generated of the vegetable or animal matter in the mould, will form an explosive mixture of the most dangerous kind, and will destroy any mould if it explodes. The mouth of the air pipe may be covered with burning shavings, but it is advisable first to lay over the mouth of it a piece of wire-gauze, to prevent the falling in of any dirt or fire. If there is fire in the pipe before the air is moving,

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that is, before there is any metal in the mould, an explosion will take place.

Removing of the Core.—As soon as the casting is done, the mould is dug up, and a portion of the core removed before the cast is entirely cooled. Cylindrical castings are liable to be split by the core, if the core is too strong. For these reasons the core is made chiefly of sand, and only enough of clay is used to keep it together. Brick cores are preferable to loam cores, if put together with sand and thick joints, because bricks offer some resistance to the fluid metal by their mass, and are easily moved by a strong power, such as metal in the act of contraction. This is one of the evils attending iron core pipes. If there is no hay-rope or a thick layer of sand around a core-iron, the casting will split upon the core before it is cool, and before it can be prevented. In all cases it is advisable to remove the core as soon as possible, and if it cannot be taken out altogether, then remove at least a part of it, that is, cut it in some place so as to afford room for the contracting cast.

Moulding without Thickness.—As an illustration of moulding in loam without thickness, which is certainly the most advantageous plan of loam-moulding, we will describe the moulding of a cylinder.

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The operation is similar in all cases: whether for a steam-engine, a blast-machine, or a cylinder for any other purpose; for illustration, however, we prefer that of a steam-engine, as the most complicated. In cases of narrow cylinders it is preferred to have the core fixed, and move the cope, particularly where the latter is to be divided. Dividing the cope ought to be avoided, if possible, for it is almost impossible to make a correct casting in such a mould. We will take a case for illustration where core and cope are each in one piece, and the latter stationary, that is, moulded in that place where the cylinder is to be cast. In this instance the mould for the cope is put in the pit, the same as the mould of the pan, above described, and founded the same way upon a platform. It is not advisable to make the cope above ground, even if there is a crane strong enough to carry it to the pit. In a mould like this, a crevice may open in transporting it, and give access to hot metal, which may frustrate the purpose for which the mould has been made. In figure 22, the moulding of a short

cylinder is represented, such as is now used in steam-engines to turn the screw propellers of steamboats. A pattern of the steam-ways is made in wood, solid, as represented in figure 23, which figure shows a side

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elevation, and a view from above. This block has the length of the cylinder between its flanges, and in

Fig. 22.

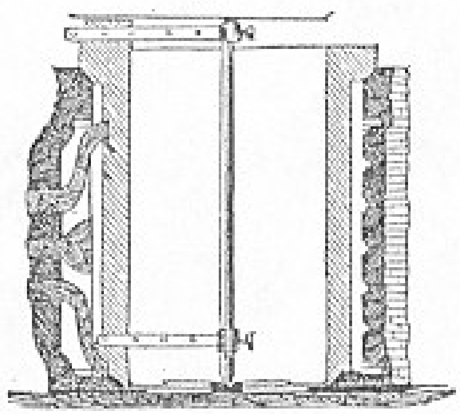
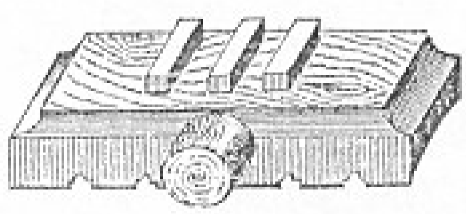


Fig. 23.



case there are any mouldings in the flange which run across the steam-ways, they are to be moulded in the wood. The three core-prints are of considerable length, because the cores find here their chief support. The middle core finds another support in the opening for the exhaust pipe, as shown in figure 23. One side of the pattern is hollow and cylindrical, fitting the exterior diameter of the cylinder, or the sweep of the loam-board. Having laid

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the platform, erected the spindle, and screwed in the loam-board—which is almost a straight board, with the exception of the two knees, one above and one below, and the moulding or hoops around the cylinder—the brick enclosure is laid, leaving from two to two and a half inches space for loam. The pattern of the steam-ways is fastened, just touching the loam-board in its travel upon its axis, and walled in, giving it a loam coating where the bricks touch it. After the brick wall is nearly dry, a coating of loam is given; this loam may be pretty strong, and mixed with hay, for the pressure upon it will be great, and if the loam gives way to this pressure, the cylinder will be defaced. This coating is superficially dried, and another coat of hair-loam laid on, which is to reach very near the loam-board, so that the last coating is but a little thicker than a clay-wash. In drying the previous loam coats, and making the coats thin, an almost perfectly smooth surface of the mould may be obtained. It will be as round and straight as a turned and polished iron cylinder, and of course the casting will be similar to the moulding. Clay which shrinks a great deal, or is plastered on in too heavy coats, causes uneven and rugged surfaces in the mould, which is the case also if the ground is not dry before the last washing

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is performed. A good facing is as smooth, sharp, and distinct in its outlines as a well made pattern of wood. The blackwashing is here to be the very last operation, and to be well performed, and when dry must be polished by a large sleeker fitting the circle of the cylinder. Before the blackwashing of the cylinder is performed, however, the steam-ways are moulded; while the cylinder is under the influence of the fire. The pattern of the steam-ways is covered by hair-loam, leaving the core-prints projecting, so as to afford access to the interior through the holes left by the core-prints. The pattern receives two or three coatings of loam, sufficient to make the loam at least two inches thick. Close to the brick, or as far off as the square of the pattern goes, a groove is cut in the loam, around the pattern, indicated by the dotted line, figure 23. This groove cuts the loam nearly through, so that the mould may be separated at this mark. The mould around the steam-ways pattern is provided with iron, bent around it, and also irons bent around the cylinder. These irons meet at the joint or parting, and are secured in their places by wire and loam, the ends of the irons at the parting terminating in hooks. Fastening a mould in this way by iron straps is convenient and advantageous, and answers every pur-

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pose, if the mould is made strong enough. If a cope is made too weak because of the iron straps, the above is a bad fastening, and the cause of failures or imperfect castings. Fastening a mould with iron is expensive, and where it can be avoided it is advisable so to do. In this instance it can be avoided, and the mould may be made serviceable without iron fastenings. When the steam-ways pattern is re-

moved, and the mould ready to be closed again, it is simply closed and secured by brick-work, which latter is commenced at the bottom. While the brick-work is progressing, the cope of the steam-ways is secured temporarily by some wire fastened around the cylinder. The brick-work forming the enclosure to this part of the mould is dried by external fire, or the united heat of the fire inside and outside of the mould.

The cores, forming the steam-ways, must be strong and porous. They are to be as long as the hollow they are to form in the casting, to which is to be added the length of the core-prints. Cores of this description are generally moulded in a wooden core-box; but this plan is not to be recommended, for wood will twist and warp, particularly where it is wet on one side and charring hot on the other, as is the case in this instance. The best plan of mak-
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ing the cores, is to make a wood pattern of a core-box, and cast it at once in iron and in open sand. In such an iron box, a good and correct core may be made without much labour. The cores for the steam-ways are made of strong loam, and provided with several core-irons, which are rods of quarter or half inch square iron, bent in the curves of the core. The core-irons are dipped in strong clay-water before they are buried in the core.

Besides the core-irons, strings of hemp, cotton, or straw, are laid in the core, which burn out in drying and form channels for the escape of air. A great many of these strings may be used, but they must be thin, so as to arrest the fluid iron, in case any of it finds access to the interior of the core. The core-loam may contain cow-hair if necessary, but this is a matter which depends entirely on the quality of the loam of which the core is made. The cores, after being moulded, are heated to redness in a coal fire, with liberal access of air, to expel every trace of water, vegetable and animal matter, and carbon. When well burned, the cores receive a good black-washing of black-lead and clay, as little as possible of the latter. These cores are the very last to be put in the mould.

Core for the Cylinder.—While the cope of the
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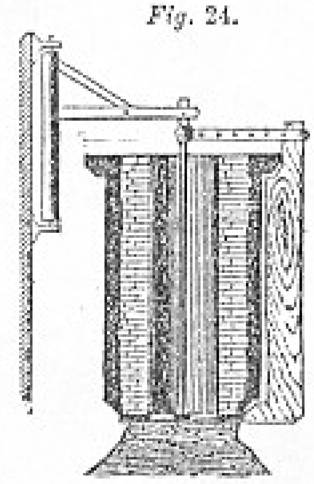
cylinder is progressing, the core for it is moulded somewhere near it, on the floor of the foundry, but within the sweep of the crane. The core is founded upon an iron platform, which has its snugs inside, and its diameter is six inches less than the diameter of the interior of the cope. The platform of the core is to rest upon the platform of the cope. The core is

Fig. 24.



simply built of bricks, finished in loam, blackened and polished, and is then ready to be set in its cope. The core has two knees, one below and one above, which are at an angle of 45°. These two knees are necessary to keep the core in its position. In case the metal is liable to porosity, which is frequently the case with some of the anthracite iron, and generally so with charcoal iron, it is necessary to prolong the mould of the cylinder, above its flange, as shown
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in the drawing, figure 24, into which the sullage rises. In cast iron which does not form holes, or raise any sullage, this precaution is not required. Upon the sullage piece, or in want of that, upon the upper edge of the cylinder, the flow-gates are set, of which there are to be at least two or three, and more if the iron is doubtful and the diameter of the cylinder large. Before the core is put in its place, two rests for the steam-way cores are cut into it. The steam-way cores are suspended only at their two ends, and liable to be lifted out at the centre core. A deep rest in that core, or an iron fastening which passes through that core, is required to secure it in its place, when the cylinder core is set and well secured, resting upon the platform of the cope, where it is secured by iron wedges. For these reasons the knees of the mould may be made to catch before the platform plates touch one another, and the space left between them can be filled up by iron wedges or scraps. The cores of the steam-ways, when put in, are well secured to the core, and then the cope of the steam-ways put in its place. The cores are after this

secured in the openings left by the core-prints of the pattern, and well stopped up by moist loam, which is to be dried. In many cases, that straight part of the steam-ways cope where the cores pass through,

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is covered by an iron plate, coated with loam, and the core-irons fastened to this plate. This caution is unnecessary, as the projecting cores can be well secured by dry brick-bats. The mode of fastening, however, depends very much on the size and form of the steam-box, and the form of the cores.

The burying of the mould and ramming-in of the sand is done in the usual way, but here the space below the mould is filled with sand and well secured, to prevent the hot metal entering below the core, in case the lower knee does not fit tightly, which in this case is always doubtful, and cannot be secured beforehand. The interior of the core is also filled with sand, if there is any doubt of its being strong enough and tight. It is better when there is no sand in the core, at least but very little in the bottom of it. The opening of the core at the top is covered by an iron plate which is well secured, leaving but a small opening for the escape of the gases; which opening is, as in any other instance, covered by a piece of wire gauze and burning straw. The whole mould is covered, as well as the core-plate, with a load of iron or screws, to prevent any motion of the core or cope by the static pressure of the fluid metal, for the least lifting will inevitably

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destroy the cast. The cast-gate is at the lower flange, and the metal is to rise gradually from below.

The cores of the steam-ways are often of such forms as not so easily to be secured in their places, which is particularly the case with the middle, or exhaust core. In this, the assumed case, there is no difficulty; for we have two strong core-prints, and the core cannot be large, as the steam-chest is but small. If a core-print can be given on each side of the chest, there will be no difficulty at all, for then the core has three points to rest upon, and can be made safe enough. If the other two cores are strong enough to take strong core-irons, there is no danger of their failing. Where such advantages cannot be had, and where the cores are in danger of being lifted off their seats, it is necessary to secure the cores by chaplets, which are put between the cores and the cope of the steam-ways, for there are none applicable to the core of the cylinder.

The use of chaplets in the steam-ways cannot be recommended, if it can be avoided by any means. The chaplets must be strong and of good wrought iron, or the fluid iron will melt or dissolve the chaplets, and the effect is worse than if they had not been used; for the moulder depended upon a support which failed, and would have done better without

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supports. If chaplets are not made of good and very pure wrought iron, they are liable to melt, or are dissolved in the mass of cast iron. The greater the amount of the latter and the longer it keeps fluid, and the hotter it is, the greater is the danger of the chaplet being destroyed. Impure iron, or iron which contains much cinder, or thick scales of hammer-slag, is apt to produce holes in the casting, for the oxygen of the scales, or cinder, will combine with the carbon of the cast iron and form carbonic oxide, which cannot escape, as it is in the interior of the casting, and the iron next to the mould is generally chilled before such gas appears.

General Remarks on Loam-Moulding.—Precautions which are to be taken in loam-moulding in general, are to be particularly observed in moulding steam cylinders, for here the object is to make a smooth, well finished casting, and one of compact sound metal, free of pores or holes. To accomplish this, particular attention must be given to the following requisites: A strong but still a porous loam; drying in coats; a well smoothed facing before the blackening is put on; well burnt cores for the steam-ways, and the air-holes in these so small and so arranged, as to prevent any possible entrance of hot iron into these air channels; the absence of all chaplets if

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possible; and every part of the mould well dried. The bearing down of the mould, and the stamping in, are operations which are in all cases the same.

If there are any square or unusual forms on a cylinder, as, for example, if one or both flanges are square, or if there are extra steam-ways, or ornaments, all such forms are made in wood or in metal (the latter is preferable), buried in the mould, and removed before the finishing of the mould.

Irregular Forms.—Where forms are to be mould-

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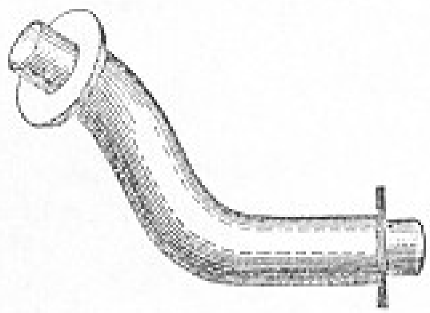
ed which do not permit the use of the spindle, a loam-mould is made either by hand, or over a wood pattern. There are also cases where both instances happen in one mould. We will illustrate this by giving an instance of the first and an instance of the latter case. In figure 25, a bent pipe is represented, which cannot well be moulded in sand, and for which

Fig. 25.



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a loam-core is to be made in every instance. It may be moulded in sand or in loam. This pipe forming a knee, is bent in such a way as to make the moulding over a wood pattern and in sand almost out of the question. The first step taken is to make a drawing of the actual size of the object upon a board, and in drawing two or three sections of it, giving sufficient length for the core-prints. This board is given to the blacksmith, and one or more bars of iron bent in the shape of the core, and these bars united to form the core-iron. If the pipe is more than eight inches in diameter, these bars are to be laid around small rings, forming in this way an open channel in the centre of the core. These iron bars are covered with hay-rope as usual, and then by loam, which latter is laid on by hand, referring repeatedly to the drawing. The last loam coating is thin and well smoothed off, before the parting-blackwash is given. In such cases as this, it is all important to have the flanges at the right distance and in correct angles; and as such castings generally are designed to fill a space or form a connexion between two pipes, it is necessary to form a skeleton pipe of two boards, of which each fits to the flange of the corresponding pipe. Such a skeleton is easily formed by nailing boards together in

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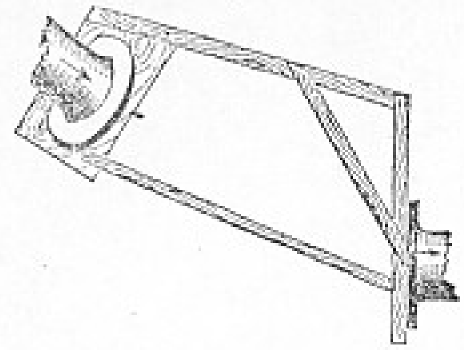
that place where the pipe is to be. Figure 26 will show how it is performed. The boards are fitted and nailed together, stayed by some lath, and the place of the flanges marked by scribing around them. Over this another skeleton of boards is made, so as to have

Fig. 26.



the dimensions of the pipe inside which are here outside, with the addition of one-eighth of an inch for each foot in the length of the pipe, for shrinkage. In this latter skeleton the inner diameter of the pipes is marked and cut out, the newly made core laid in this board skeleton, in the exact position in which the new pipe is to be attached to the other pipes. The core is fastened in this position to the skeleton, and the "thickness," which of course includes the flanges, is laid on the core, and gently dried. When the thickness is so far dried as to be secure against warping, it is removed from the skeleton boards, dried, blackened, and the cope put on. If the pipe

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is heavy the cope is to be fastened with iron, taking care to have the parting free. Moulds for light pipes may be secured by a succession of wire fastenings which are laid at certain distances around the cope. The parting of the cope is done as usual, by cutting two grooves along the pipe in such a direction as to divide the cope into two halves, but so that each half may be lifted off the core. If the flanges or the thickness break off in removing the cope there is no harm done, if the core is not damaged in this operation. After the usual finish of the facing, the mould may be put together, and rammed in sand as usual. In this case the core cannot be kept in its place without chaplets, and a liberal number of them is to be distributed between the core and the cope. This pipe is rammed in and cast in the usual manner.

When the object to be moulded presents more complicated forms than the one represented, the experience of the moulder must be his guide in forming the plan of the mould. Analogous processes are here everywhere, but it is the sagacity of the moulder which gives to the most complicated forms tangibility, which analyzes a pattern, and finds a mode of execution in cases where success at first

sight appears to be impossible. If the form of a
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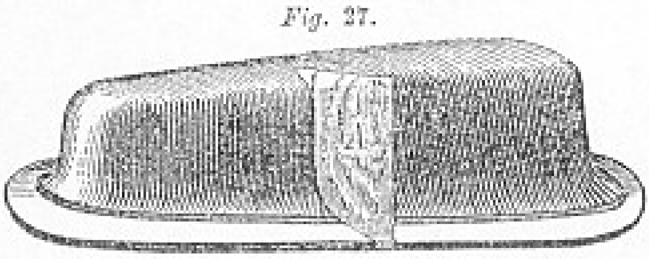
pattern does not happen to be divisible into two parts, or permit a mould of two parts, there is no objection to dividing it into three, four, and more parts, but it is a rule to make as few partings as possible. In every mould, it is to be a standard rule to provide liberally for the escape of the gases. If forms are to be moulded which require more than two platforms, there is no objection to taking as many as may secure the greatest advantage and security to the mould.

Oval Forms.—Oval, curved, or triangular forms must be traced by corresponding platform-plates, for no application of the spindle is possible in these cases. For example, to mould an oval bathing-tub, without a pattern, a foundation plate in the form of the upper side of the tub is cast in open sand. There is no need of its being solid—it may be an oval ring. Figure 27 represents the

Fig. 27.



moulding of such a tub. The loam-board A is guided by hand around the platform, and if kept in close
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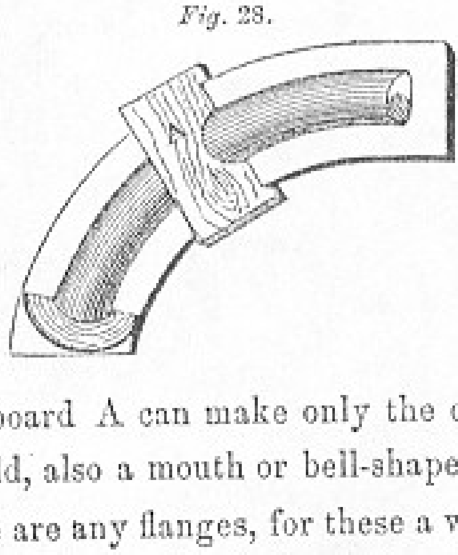
contact with the edge of the plate, there is no difficulty in obtaining a correct mould. If there are any projections, or departures from the regular form, they are made by hand. Curved forms are made in a way similar to the above. A core, or a mould to an elbow pipe, is moulded on a platform which has the form of the curved pipe, as shown in figure 28.

Fig. 28.



The loam-board A can make only the current part of the mould, also a mouth or bell-shaped widening; but if there are any flanges, for these a wood pattern is to be made. In this instance two halves of a pipe-core are made; and these joined by moist loam and wire. In most instances of this kind a wood pattern of the object is made, and this moulded in sand; but as the core of such forms cannot well be moulded in sand, it is made in loam and applied in the usual way. Square forms of objects which are to be moulded without patterns, are made in a similar
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manner as those of an oval or irregular form; such moulds, however, require more strength than the moulds of round forms, for the pressure of the fluid metal upon a plain surface, tends to drive the core and mould apart, with more energy than it does in round forms. To guard against this pressure in flat or straight forms, is an object which requires some judgment on the part of the moulder.

If complicated forms are to be moulded, the best plan always is, first to make a pattern in wood of the object. Even if the pattern is not used in moulding directly, it is of great service to the moulder, in having a form to imitate, which is more plastic to his mind than a mere drawing. All heavy and complicated castings, such as heavy bed-plates for steam engines, housings, and rollers for iron works, are moulded in loam, if good work is expected. The heat and pressure of a mass of hot iron like that poured into the mould for the bed-plate for the engines of the Collins Atlantic steamers, being forty tons or more, will destroy any sand mould, no matter how carefully made. Complicated forms of this kind are partly made to drawings and partly over wood or metallic patterns. We will illustrate this subject by an instance which is not complicated, but sufficiently so to show the principle upon which
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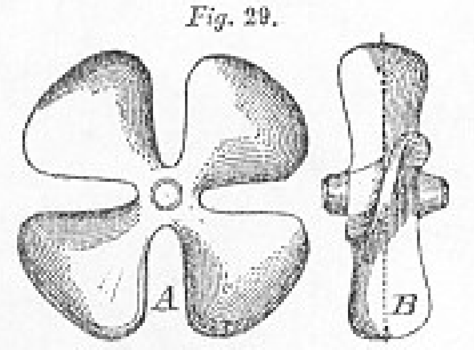
a mould of this kind is constructed. In figure 29 a screw-propeller is shown, such as are now frequently used to propel steamboats. These propellers are cast in iron, copper, brass, or bronze; this, however, does not cause an essential difference to be made in constructing the mould. The four wings of this

Fig. 29.



pattern are twised as shown in B. It is advisable to make a wood pattern of this propeller, dividing it at the dotted line in B into two halves. An experienced moulder will prefer to make the mould by hand, but generally the pattern is buried in the loam, and kept there until the mould is nearly dry. There is little difficulty in moulding this object in the latter way. As the pattern is divided, the one half is moulded upon an iron platform, the larger spaces filled by brick, and over these the usual coating of loam. The four wings of the pattern are fastened by wood-screws to the nave, which may be

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drawn and the pattern removed in parts; this forms the lower part of the mould. The other half of the pattern is moulded in parts, upon quadrant plates, with its dividing side downwards. The mould of this half is taken apart, each quarter resting upon its quadrant platform. These four quarters are set upon the first half of the mould which is whole, and has a solid platform. The edges of the four wings or paddles are generally sharpened out, so that there is little difficulty in hitting the thickness of the paddles. A better mould than that described may be made by hand; it is then divided into two halves as the above, but it affords a better opportunity of having the facings of the mould correct and uniform in texture. Many screw-propellers are moulded by dividing the pattern at the nave, and making a cope over each paddle, which is fitted and fastened to the cope of the nave. The first way of moulding is preferable to the latter; it is perfectly safe, and makes a more correct and smooth casting.

Moulding of Bronze Ornaments.—The art of casting bronze statues has been traced to remote antiquity, and, to all appearance, the ancients were more skilful than the moderns in this art. Bronze statues were so plentiful in Greece at the time of Alexander the Great, that Pliny calls them the mob

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of Alexander. It is recorded that the Romans found 3000 bronze statues in Athens, and as many in Rhodes. The Temple of Solomon was adorned with heavy and richly ornamented bronze castings. The pillars of Jachin and Boaz at the portal were of bronze; the molten sea of the priests to wash in, was cast of bronze, and the metal basins at the entrance were of the same metal. The world-renowned Colossus of Rhodes was a bronze statue of 130 feet high; it was broken by an earthquake fifty-six years after its erection, and its remains lay scattered over the ground for nearly nine hundred years, when they were sold by a king to a Jew, who carried at that time 360 tons of metal away. More recently, in the middle ages, bronze was extensively used for doors and gates of churches and cities. The doors at the Battisterio in Florence were of such exquisite workmanship, that Michael Angelo, the great architect of St. Peter's at Rome, declared that these gates were worthy to be the gates of heaven. More recently, in our own times, this beautiful art has been degraded to the manufacture of implements of war, and in other cases to celebrate the memory of military heroes—an application no better than the other. The ancients were not acquainted with a definite alloy, to make their bronze

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castings of. Their mixtures were accidental; but we will speak of this hereafter.

Moulding of Statues.—The mode of forming the moulds for bronze castings of large size, as statues and bas-reliefs, was never reduced to a systematic art. There is satisfactory evidence to show that the knowledge of this art lay dormant for centuries. The ancient Greeks were the most skilful in the execution of statues of this kind, not only so far as form is concerned, but also in their preparation of the moulds and the casting of the statue. Their plan of making a mould, was to make a skeleton of plastic clay, which was to form the core. This skeleton was kept wet—just as the sculptors of the present day mould a figure in clay—and made into an exact mould of the figure to be produced. Over this wet clay pattern the cope was made, and so far dried as to admit of removal, after which core and cope were finally dried and burned. The space resulting from the shrinking of the core, formed here the thickness for the metal. The way in which such a mould was made is an evidence of the high skill of the artists of that time; for in case the casting fails, all the labour of the artist and the moulder is lost, for pattern and mould are destroyed at each cast. It requires

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great experience and skill to succeed in this mode of casting statues and larger ornaments.

French Mode of Moulding Statues.—A more safe, but very expensive plan of making moulds, was practised in the seventeenth and eighteenth centuries. The pattern for larger statues was made of plaster of paris, instead of clay, because the latter shrinks a great deal in large masses. This plaster was laid on and fastened to a skeleton of iron. Over this pattern, which might be either an original or a pattern at hand, a cast of plaster is made, and this plaster mould divided so as to remove it conveniently. Over parts of this plaster mould coats of wax are laid, which form the "thickness." The wax is a compound of six parts of wax and one of white pitch, with which a little tallow or oil is mixed. The plaster mould receives a film of oil before the wax is put on, and the first coating of wax is laid on warm by means of a paint brush. A skeleton of iron bars is now made, composed of heavy and small iron, also iron wire and wire gauze, having, as near as possible, the form of the object to be cast. The segments of wax are fastened to this iron skeleton, and finally the whole surrounded by the plaster cope. Into this hollow mould, which is composed of the cope of plaster, a thickness of wax, and an iron

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skeleton in the interior, the cement forming the core is cast. This cement is composed of two parts of plaster of paris, and one of brick-dust, or ground bricks, cast through an opening made in a convenient place as high as possible on the mould. When this core is hardened, which takes but a short time, the plaster cope is removed, the damages in the wax mould repaired, and a number of small gits for conducting the metal, and other gates for letting out the gases, are fastened around the figure. These gates are made of wax, from half an inch to one inch thick, and fastened to the figure in such places where the least injury will be done. None are to be on the face, hands, or other delicate parts. Small wire is used to keep these gates in their places. The final cope is then made in the usual way of sand-loam, mixed with cow-hair, or horse-dung. The first coating on the wax figure, however, consists of finely ground brick-dust, mixed with the white of egg or glue, forming a kind of paint. This is painted twenty times and more over the pattern. After this first coat follows a coating of hair-loam, and finally horse-dung loam. This loam-cope is to be provided with iron fastenings, and at last receives a brick enclosure, which is also secured by iron binders. Below and around this mould fire-places are erected,

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which are so distributed as, when fire is made in them, to make the mould uniformly warm outside and inside, and heat it to an almost red heat. The wax forming the thickness is the first that flows out, and leaves a space in the mould of the same thickness as the cast is to be. The quantity of metal needed to fill the mould is exactly that space occupied by the wax. This process of moulding is complicated, but it is safe and insures good castings. It has the advantage over the Grecian mode, that the original pattern, the plaster cope, is never lost.

By skill and dexterity the artist may shorten the above process. One way is to build the plaster cope directly over the iron skeleton for the core, cast the mould full of core-cement, remove the plaster cope, and shave the "thickness" off the core. Then put the plaster cope again around this core, and cast the thickness space full of wax. Over this wax cast, the loam cope is made, as described above.

At the present time there is no settled system in the casting of bronze statues: the artists follow their own individual inclinations and experience. In many instances cores are built up first, covered by hand with loam, and burned; then the wax is put on, and the pattern made upon the core; over this pattern the loam cope is moulded, the wax melted out, and

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the mould filled with metal in the usual way. In this way the pattern is lost. In other cases they make a core as above, cover it by wax plates made in the plaster mould, and proceed as described before. All the difference from that described in the past pages is here the making of the core, which, if made in the latter way, is more perfect, and more certain to secure success.

Iron Statues require more metal than bronze statues, and also strongly burnt moulds. Here the core is built up first, and the "thickness" laid on in fine clay. The pattern is made by the sculptor upon the core. The cope is made and divided as in common loam-moulding, the thickness removed, and the mould put together with that caution required to make the operation successful. The pattern

of course is lost, and if the casting fails it is to be made anew. A mould over a pattern at hand, may be made over that pattern, but the core is to be made by hand. In all cases core as well as cope are to be well provided with iron stays, and chaplets, and are to be perfectly dry. If such cautions are taken, there will be no failure in casting.

Bas-reliefs.—Flat bronze castings, as ornamented pannels, facings, and single ornaments, are cast in the usual way in iron flasks, in new sand, and dried.

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If the patterns are too complicated, or underworked, so as to make many cores necessary, the facing of the mould is made in fine strong sand, entirely composed of cores, and over these cores, as a parting, the whole of the cores are covered with common moulding sand and dried all together. The parting between the cores and the sand is made by common parting-sand. To avoid the division of the mould, the patterns are frequently cut in such places and directions as to remove the pattern in parts. This latter mode of moulding, because it is the cheapest, is practised in the manufacture of articles which are in common use.

Moulding of Bells.—Small bells are generally moulded in sand, from a metal or wood pattern, and the sand mould is dried in a stove, as before described. We shall give no description of the manufacture of small bells, to which class bells of from one hundred to two hundred pounds' weight belong, but confine ourselves to a description of the moulding of the larger kinds. The most important part of this art, is the construction or the form of the bell. Another equally interesting is the composition of bell-metal. In this place we shall only speak of the moulding of a large bell. In figure 30, a mould is represented as it is sunk in the pit

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for casting. There is no essential difference between moulding a bell and a cast-iron kettle. The core is built in brick upon an iron platform, which is to

Fig. 30.

have snugs, in case the mould is made above ground. This brick core is covered with three-fourths of an inch or one inch thick of hair-loam, and the last surface-washing is given by a finely ground composition of clay and brick-dust. This latter is mixed with an extract of horse-dung, to which is added a little sal-ammonia. Upon the core the "thickness" is laid in loam-sand, but the thickness is again washed with fine clay to give it a smooth surface. Ornaments which have been previously moulded, either in wax, wood, or metal, are now pasted on by means of wax, glue, or any other kind of cement. If the ornaments are of such a nature as to prevent the lifting of the cope without them—for the cope cannot be divided—the ornaments are fastened to

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the thickness by tallow, or a mixture of tallow and wax. A little heat given to the mould will melt the tallow, after which the ornaments adhere to the cope, from which they may be removed when the cope is lifted off the core. The thickness is to be well polished; and, as no coal can be used for parting, the whole is slightly dusted over with wood-ashes. The parting between the core and the thickness is also made with ashes. The cope is laid on at first by means of a paint-brush, the paint consisting of clay and ground bricks, made thin by horse-dung water. This coating is to be thin and fine; upon it hair-loam, and finally straw-loam is laid.

The crown of the bell is moulded over a wood pattern, after the spindle is removed. The iron or steel staple for the hammer is set in the core, into the hollow left by the spindle. It projects into the thickness, so as to be cast into the metal. The facing of the mould ought to be finished when the cope is lifted off. Small defects may occur, and are, if not very large, left as they are; the excess of metal in those places is chiselled off after the bell is cast. All that can be done in polishing the facing of the mould is to give it a uniform dusting of ashes. When the mould is perfectly dry, it is put together for casting. The core may be filled with sand, if

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preferred, but there is no harm done if it is left open; for bell-metal does not generate much gas, and there is no danger of an explosion. The cope is in some measure secured by iron, but its chief security

is in the strong, well rammed sand of the pit. The cast-gate is on the top of the bell, either on the crown, or, if the latter is ornamented, on one side of it. Flow-gates are of no use here, the metal is to be clean before it enters the mould: there is no danger of sullage.

Moulds consisting partly of loam or sand, and partly of metal, are in frequent use in iron foundries. Small car-wheels, boshes for cart-wheels, and car-wheels for mining establishments, receive their bore by being cast over an iron or steel core. Such a core-iron is a little tapered, to admit of its being freed from the casting by a smart stroke of the hammer. The casting is never left to cool entirely before the core is removed. It is generally removed when the casting is hot, but so far cooled as to resist the drawing out of the core-iron.

Chilled railroad-car wheels are another article where iron is employed as a part of the mould. The cast and chilled railroad wheels now in general use, are cast in a mould composed of green sand and iron. In figure 31 is shown a mould in which a chilled

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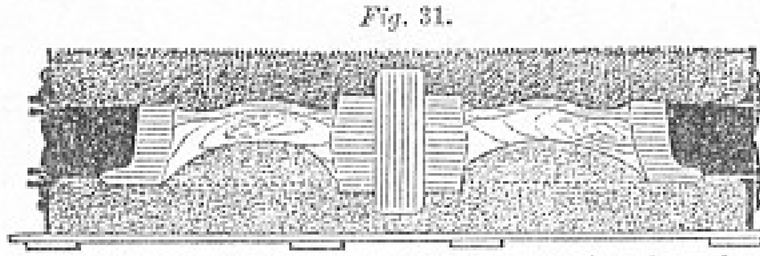
wheel is cast. It consists of three boxes. The lower is a box of common round form, merely to hold the sand and give support to the centre core

Fig. 31.



and the middle box. The upper box is of a similar form, also round. The middle box is a solid ring cast of strong gray or mottled iron, and bored out upon a turning lathe, giving it the reverse of the exact form of the rim of the wheel. This middle box ought to be at least as heavy as the wheel is to be after casting, and it is preferable if it has two or three times that weight. All the three boxes are joined by ears and pins as usual, and the latter ought to fit well without being too tight. The chief difficulty in casting these chilled wheels is to make the cast of a uniform strain to prevent the wheels from breaking. Wheels with spokes or arms are very liable to this evil, and are to be cast with their hubs divided into three or more segments, which are afterwards banded by wrought-iron tires before fastening them to the car axles. At present, most

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of these wheels are cast with corrugated discs or plates; in this way the hub may be cast solid, and the wheel is not so liable to be subjected to an unequal strain in the metal as when cast with spokes. In such plate-wheels the whole space between the rim and the hub is filled by metal, which, however, in most cases is not more than three-quarters of an inch or one inch thick. The rim of a good wheel is to be as hard as hardened steel at its periphery, but soft and gray in its central parts. The first requisite is more safely attained by having a heavy chill; but if the chill is too heavy, the inner parts are apt to suffer the cooling qualities of the chill. Success in this branch of founding depends very much on the quality of the iron of which the wheels are cast; but of this we shall speak again in another place. Soon after casting such wheels it is advisable to open the mould, and remove the sand from the central parts, so as to make it cool faster; this precaution saves many castings, not only in this particular case, but in many other instances. Uniformity in cooling is as necessary to success as good moulding. The thinnest parts of castings which cool first, will invariably break; but if a casting cools uniformly, there is no danger of strain in the metal.

Chilled Rollers.—One of the most important cases

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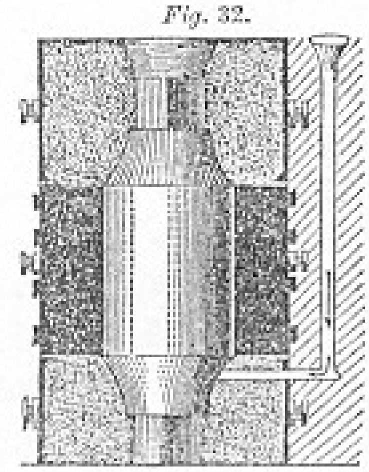
of this kind of moulding and casting in iron moulds, is the casting of chilled rollers. There are some good chilled rollers manufactured in the Western foundries, particularly at Pittsburgh. We will not allude to any particular case, but describe the process of making chilled rollers, generally. The mould for a chilled roller consists of three parts, as shown in figure 32. The lower box of iron or wood is

Fig. 32.



filled with "new sand" or a cement, a strong com-

position of clay and sand, in which a wood pattern is moulded which forms the coupling and the neck of the roller. The middle part of the mould is the chill, a heavy iron cylinder well bored. The upper part of the mould consists again of a box, but is higher than the lower box, so as to make room for the head in which the impurities of the iron, "sullage,"

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are to be gathered. The two boxes with their contents of sand are to be well dried. In many establishments the two ends of the roller are moulded in loam, over the chill, to secure concentricity of roller and coupling; but this can be quite as safely arrived at by fitting the ears and pins of the boxes well to the chill. The chill is the important part in this mould: it ought to be at least three times as heavy as the roller which is to be cast in it, and provided with wrought-iron hoops to prevent its falling to pieces, for it will invariably crack if not made of very strong cast iron. The iron of which a chill is cast is to be strong, fine-grained, and not too gray. Gray iron is too bad a conductor of heat; it is liable to melt with the cast. Iron that makes a good roller will make a good chill. The facing of the mould is blackened like any other mould, but the blackening is to be stronger than in other cases, to resist more the abrasive motion of the fluid metal. The chill is blackened with a thin coating of very fine black-lead, mixed with the purest kind of clay; this coating is to be very thin, or it will scale off before it is of service. The most important point in making chilled rollers is the mode of casting them, and the quality of iron used. Of the latter we shall speak in another place. To cast a roller, whether a

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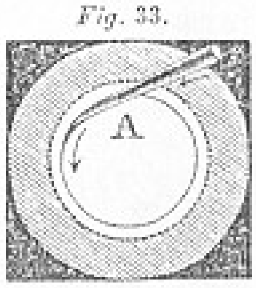
chilled roller or any other, from above, would cause a failure, for the roller will be useless. All rollers are to be cast from below. It is not sufficient to conduct the iron in below; there is a particular way in which the best roller may be cast, for almost every kind of iron. The general mode is represented in figure 33, which shows the upper

Fig. 33.



side of the lower box. In A is represented the cast-gate and channel, as it is seen from above. The gate is conducted to the lower journal of the roller, and its channel continues to a certain distance around it; it touches the mould in a tangential direction. In casting fluid metal in this gate the metal will assume a rotary motion around the axis of the roller, or, which is the same, the axis of the mould. This motion will carry all the heavy and pure iron towards the periphery or the face of the mould, and the sullage will concentrate in the centre. It is a bad plan to lead the current of hot iron upon the chill, for it would burn a hole into it,

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and melt chill and roller in that place together. The gate must be in the lower box, in the sand or the loam-mould. The quality of the melted iron modifies in some measure the form of the gate, for stiff or cold iron requires a rapid circular motion, while fluid, thin iron is to have less motion, or it is liable to melt to the chill. The roller is kept in the mould until perfectly cool, but the cooling may be accelerated by digging up the sand around the chill.

Casting Iron to Steel.—One branch of moulding and casting we have to mention before we leave this subject: it is the casting together of iron and steel. At present many anvils, vices, and other articles are made of cast iron, mounted with steel, which are in a fair way of driving all the wrought-iron articles of this kind out of the market. The welding together of steel and cast iron is not difficult, if the steel is not too refractory. This process will not succeed at all with German or shear steel, and hardly so with blistered steel, but it is easily performed with cast steel, by soldering it to cast iron by means of cast-iron filings and borax. Of the manufacture of these cast-iron articles with steel faces we can give but the outlines, having had no opportunity of becoming thoroughly acquainted with this branch. The cast-steel plates to be welded to the faces

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of anvils, are generally from a half to five-eighths of an inch thick, and as wide as the face itself. These are ground or filed white on one side, and then covered on that side with a coating of calcined borax. The plate, with the borax on it, is heated gently until the borax melts, which covers it with a fusible transparent glaze. The plate in this condi-

tion is laid quite hot in the mould, which latter is made of dry and strong sand. The iron is poured in and rises from below; the steel plate being the lowest part of the mould, it will have the hottest iron. The heat to be given to the iron will depend in some measure on the quality of the steel; shear steel requires hotter iron than cast steel. The cast iron used for these purposes, is to be strong and gray, but not too gray, or the union of the iron and steel is not strong. White cast iron will not answer in this case, partly because the casting would be too weak, but chiefly because the cast iron would fly or crack, in hardening the steel. The hardening is done under a considerable heat, with an access of water falling from an elevation of ten feet or more.

Moulds for Lead, Tin, &c. &c.—Besides these moulds of sand, loam, and partly iron, there are moulds which are entirely constructed of metal, either of iron, copper, brass, or bronze. Such

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moulds are used for casting tin, lead, pewter, Britannia metal, zinc, types, and other articles of economy and ornament. Brass or bronze moulds are generally preferred to iron moulds, because they do not corrode as iron moulds do, and retain a more perfect polish. Such moulds are constructed on the same principle as sand or loam-moulds. If a metal mould is divided into two, three, or more parts, each part is provided with a handle sufficiently long to protect the hands against the heat of the mould. The parts of such a mould must be nicely fitted together, and kept in their position by ears and pins, or in many instances by wedges. The mould is gently heated before any metal is poured into it, to secure the filling of the space in the mould, for many of the most fusible metals and alloys cannot lose much heat from melting to congealing. The moulds must be well polished after each cast, and are then rubbed over with a rag containing oil or tallow, and which spreads a thin film of oil or tallow over the facing of the mould. In many cases a covering or film of pounçe-powder—sandarach—beaten up with the white of an egg, is preferred, particularly for alloys. Single metals work better with oil or fat.

Moulds for Copper and Brass, if it is intended to

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make sheets of these metals, are for the first metal simply cast-iron boxes, in which the iron is from one and a half to two inches thick. These boxes are formed so as to be taken apart, for the copper will adhere to the iron if it is very hot. These iron moulds are to be very clean, or the cast of copper, which is from two to three inches thick, is apt to have holes, which makes it useless for sheets. Brass may be cast in the same way as copper, but it is more safe to cast brass plates for sheets between two stone-plates. These stones may be of granite, freestone, or any other kind of hard fine-grained quartz stone. They are to be from six to twelve inches thick, and secured against falling to pieces, in case they crack, by iron hoops. The space between the stones for making the thickness, is formed by iron rods. Such a mould is to be in the sweep of a strong crane, and is in the whole a somewhat complicated operation, foreign to our subject.

Stereotyping.—Plaster of Paris moulds are used for many articles cast of fusible metal, but particularly for stereotyping plates used in printing books. Fine plaster of paris is first cast over a page of letter composition, and this thin coating strengthened by coarse plaster. This plaster mould is dried at a boiling heat in appropriate stoves, and then dipped

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in a kettle filled with melted type metal. When the mould is cooled the plaster is broken off, and, according to the skill of the operator, a more or less true copy of the letters which served as a pattern is obtained.

There was a kind of stereotype process formerly practised, which deserves, on account of the principles involved, not to be forgotten. Before the invention of the present mode of casting stereotypes under the influence of pressure in a metallic bath, they were made simply by pressing the pattern,—which might be a wood cut, or a composed form,—upon the liquid metal, just when at the point of congelation. It was a process which required skill and dexterity, but made better casts than the present mode of stereotyping. The fine stereotyped prints made at the end of the last and the first part of this century were stereotyped in this way. The beautiful stereotypes of Firmin Didot in Paris were done in this manner. The metal used for mak-

ing the mould was lead with a little tin; this was melted and cast in a paper-box as large as the cast was to be. The fluid metal was but one-eighth of an inch thick and resting upon a level table, cooled very uniformly. The moment when the metal was going to crystallize (assume its solid form) was the time to
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put the wood engraving or form of types down upon it, with a certain force. This process, performed with skill, made better and more correct impressions than the present plaster of paris mould. This first or lead impression served as a mould for the next cast. The next cast was made of type metal, or an alloy still more fusible. This metal was cast like the first, in a low paper box, and the moment when it was going to congeal, the lead mould was with force put down upon it. This latter cast was the true copy of the pattern. The paper boxes were surrounded by a screen of sheet iron, to protect the operator against the flying hot metal. The thin film of oxide, covering the melted metal, was the means of preventing the adherence of one metal to the other. Machines have been in operation to perfect this process, and make it less dependent upon the operator; still, the present mode of casting stereotypes has prevailed over the old method, as it is supposed to be more advantageous. If there is no advantage in stereotyping letter-press in the old way, it is certain that engravings are made more perfect in that manner. The composition of the metal for this art, may be varied from the melting point of lead to the melting of an alloy which requires but the boiling heat of water.

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Impressions and Castings.—Before we proceed to the consideration of metals, we will speak of some interesting operations connected with the fine arts. We allude here only to relief impressions, not to those in ink or colours. The materials in which impressions may be made, are wax, paper, whalebone, horn, glass, sulphur, and many other materials to be mentioned in the course of this chapter. Impressions are made in many materials, and a variety of operations in the useful arts depend upon this manipulation. The operations in the mint, and stamping of medals and utensils, as spoons, forks, and pans, are parts of this branch of art; reliefs in copper, brass, and silver sheets, the pressing of wooden snuff or other boxes, of handles for canes and umbrellas, of leather, cloth, and paper, all belong to a different branch from that we are investigating. Most of this work is performed by stamping-machines and dies, where the relief part of the die is stationary, and the counterpart or intaglio moveable. Some of these operations are closely connected with our art, and for these reasons we will describe a few of them. Impressions of small objects are easily taken: the difficulty in making large impressions increases rapidly with the size of the impression. The use of impressions in this case, is
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to obtain moulds from patterns which will not bear a cast or mould, as coins, gems, &c.

Wax is one of the best materials to take impressions with; yellow wax is particularly qualified for this purpose. Before using it, it is to be gently warmed and worked between the fingers, after which it is more uniform in composition, less adherent to other matter, and stronger in itself. The only objection to it is, that it is not very durable, and is to be kept with caution to save the sharp impressions of the original. Such impressions in wax are made where the original pattern will not bear heat or water. Their use is to make plaster coats over them, and prepare the plaster cast for patterns to be moulded in sand.

Bread in crumbs, is another material for taking impressions. If this is well worked between the fingers before the impression is taken, it can be dried without cracking, and casts of sulphur, plaster, or other matter may be made in it with success.

Impressions in *sealing-wax* can only be made in cases where the pattern is not liable to injury from the heat of melted sealing-wax. In this operation sealing-wax of the best quality is required; it is to be melted in a thin layer in a metallic capsule over the flame of a lamp, and the pattern, as lapidary or seals, is impressed upon it when near the point of
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congelation. Impressions in sealing-wax are very useful for taking casts in clay or plaster, and if enclosed in a metal capsule they may be moulded in sand. The melted wax must be free of blisters, and the pattern which gives the impression very clean.

Sulphur, is a material very useful in taking impressions, but it is somewhat difficult to succeed with

it. There are two ways in which it can be done: we will mention both. If sulphur is melted to nearly its boiling point, it assumes a pasty appearance. If in this condition it is quickly cast into a large vessel of cold water, it will retain that pasty form. The detached parts may be united under water, without injury to the condition of the sulphur. This putty sulphur will take fine impressions, and regain in a few days its natural hardness. A less difficult operation is the following. In melting sulphur it first assumes a watery appearance, is clear and liquid, but by increased heat becomes brown and tough, and at last it burns with a blue flame. In this state it is cast upon a plate, where, in gradually cooling, it becomes liquid, and after this congeals all at once. When the sulphur is just beginning to harden, the pattern is pressed firmly upon it, and a good sharp impression is thus obtained.

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Glass impressions are very durable, but are not so easily made. To copy a coin, cameo, or medal in glass, an iron welded ring about a half or three-fourths of an inch high, a little larger than the pattern, is laid around it. In this iron ring upon the pattern, damp tripoli of Corfu,—other kinds of rotten stone cannot be recommended, because the chemical composition of this tripoli is the chief condition of success—is rammed on just as in sand moulding. The facing is to be the finest part of the tripoli, and worked through a fine silk sieve. When the pattern is removed, this mould is at first gently dried and gradually exposed to a stronger heat, to expel every particle of moisture. Upon the face of this mould a round piece of fusible glass is laid a little larger than the pattern, and the whole exposed to the heat of a cupola or muffle, such as assayers use for refining and assaying. The glass will soften by degrees and fill the mould, the refractory character of the silicious tripoli preventing it from melting together with it. Coloured impressions may be made simply by melting the coloured glass first down into those parts which are to be coloured, and then covering the whole with such glass as we intend the body of the impression to consist of. This latter process, however, requires two moulds, and two opera-

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tions; the first mould makes but one colour of glass, which is to be ground on its reverse, before the second or body plate can be melted to it. The glass used in this art is that of which pastes or artificial gems and precious stones are made.

Clay is an excellent material for taking impressions, but its shrinking, and consequent cracking, make it less useful as a material for taking impressions. It is most extensively employed as a means of raising ornaments upon porcelain. If coloured ornaments are wanted, the white clay is coloured by a fire-proof colour, pressed into a bronze mould, made flush with the mould by a bone spatula. The ground mass is laid over it, to which it will adhere. The contraction incident to clay impressions may be brought to useful account. By repeated moulding and drying a diminution of the original pattern may be obtained, true in all particulars, but somewhat less sharp.

Artificial-wood impressions may be made by mixing saw-dust with a solution of glue 5 parts and isinglass 1 part. The moulds for this mass may be made of metal, wood, sulphur, or even plaster of paris, covered with a film of oil. The mass is pressed into the mould by hand. Impressions of this kind are never sharp, but answer for many purposes

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instead of wood-carvings. They may be varnished and gilded like wood, but cannot be used in damp places. Saw-dust of willow, maple, gum, and similar kinds of wood, is preferable to that of hard wood, as mahogany, or pine wood. An addition of finely powdered chalk, rotten-stone, or fine sand, improves the sharpness of the impression. Clay does not answer in this composition, on account of its affinity for water.

Castings of other materials than metals are not extensively in use, but are of importance as means of making patterns.

Plaster of Paris is the most important in this range of materials. It is made by calcining pounded or ground gypsum gently in an oven: a common bake-oven is sufficient for a small quantity, for there is no other ingredient in the composition of the gypsum to be driven off but the water of crystallization. Too much heat deadens the plaster, and too little heat makes it work slow and absorb less water of crystallization. Plaster of paris exposed to atmospheric air loses its quality of hardening with water;

gentle heat in an iron kettle and stirring, restores the lost capacity for water. To work successfully in plaster, experience and skill are required, but we

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will try to give as good practical information as is in our power.

One of the first requisites to success in this work is a thorough acquaintance with the nature of the plaster. If the material is a strange one, it is advisable to calcine it in an iron kettle under repeated stirring to a red heat, or so far as the kettle will admit of, before running the risk of a cast. The quantity of water with which any kind of plaster will assume its greatest hardness, is to be tried by experiments. Some qualities absorb more water than others. The hardest casts are made with the least water, but it requires dexterity to make sharp castings of a stiff pasty plaster. The casts are also harder if warm water is used. To prevent large pores, and blisters in the cast, the solution is to be constantly stirred, and kept in motion until the plaster is hardened in the mould. The best plaster casts are made if a very thin solution is first spread over the face of the mould, and upon this, while wet yet, a stronger cast is made. This will unite strength and beauty in the same cast. Foreign matter ought not to be mixed with plaster: it invariably impairs the strength of the cast. If plaster is to be used for making patterns, one-third of slacked lime may be mixed with it. This keeps the plas-

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ter for a long time in a pasty condition, and offers an opportunity to alter the form of it so long as it is in that state. A little lime mixed with pure plaster, makes it more useful for moulds, particularly where metals are to be cast in it. The best mixture for making moulds of plaster for metal, is to mix it with one-third of finely ground pumice-stone, and a little clay. All other admixtures to improve the hardness or strength of plaster are useless. The strongest casts are casts of fresh, well burnt plaster, which was not too thin when cast. A mould of plaster may be made over any pattern which is impervious to water; therefore all patterns which absorb water are to be covered by a varnish which excludes water. In varnishing a pattern the varnish is to be laid on thin, and uniform, not to mutilate the pattern, or fill up fine cavities. As an illustration of this subject, we will give a description of some practical cases. To cast a mould of a coin, or of a wood engraving, the pattern is first brushed over with oil or soap-water, and then laid on a level place upon a board or table. It is now surrounded with an enclosure of varnished pasteboard, tin-plate, or anything light and flexible, which is to be fastened tightly around the pattern. This is to project above the face of the pattern the proposed thickness of the plaster cast—if

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it is higher there is no harm done. Plaster of paris is now mixed with an excess of water, in a common water pitcher, well stirred, and after remaining a moment at rest, the coarse plaster will settle at the bottom, and the finer portion be suspended in the water. The lighter part of this liquid is gently cast over the pattern, while the latter is constantly and gently struck, so as to settle the particles of plaster in the finest crevices of the pattern, and make air bubbles rise, which often pertinaciously adhere to the pattern. The coarse sediment of the plaster is thrown away, or saved and exposed to another fire before being used again. After five or ten minutes' standing, the fine plaster is settled in the mould, and clear water stands over it. This water is cast off as dry as possible, and some fresh plaster, mixed very stiff, is cast over the first thin facing to strengthen it. The first cast is made very thin merely to cover the pattern, for it will be too weak and porous for any practical purpose, even if cast thicker. The two casts will unite firmly, and form a useful whole, giving a very minute impression and being strong besides. Such a plaster mould is dried, to expel all the water from it, and may then be used to cast fusible metal, wax, or sulphur in. If this mould is to be used for making plaster casts, it is varnished

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first, which is done by a gum-shellac varnish, or by soaking the mould in wax. The first is the preferable plan. The first coating or facing of plaster may be put on by a fine camel's-hair brush, but this way is not so sure of making perfect impressions as that described. There is a certain time for removing the cast from the pattern; if this is done too soon the cast is too soft, and will break, and if done too late it will adhere to the pattern. For small objects, and strong plaster, from ten to

fifteen minutes is sufficient; for larger ones, from fifteen minutes to one hour will be required, before the cast can be separated from the pattern. The patterns are to be covered by a film of oil, as remarked before; this subject requires more attention than at first sight appears necessary. Pure oil is liable to fill the finer parts of the pattern and prevent the access of the plaster; it has, besides, the evil influence upon the cast that it prevents the hardening of it, and if, therefore, the cast is sharp at first, the least rubbing will abrade the facing, at least the finer parts of it. A solution of white hard soap brushed over the pattern is preferable, but if the pattern is not very well smoothed or well varnished, if of wood, the cast is apt to adhere to the pattern. In most cases a mixture of a strong solution of soap,

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and a little oil, is found to be the best parting material. Oil generally gives a colouring to the white plaster, white hard soap does not.

The Moulding of Statues in plaster of paris is not an object of general interest, and for this reason is hardly worth the pains of describing and reading an essay on it; but as it affords the best illustration of moulding busts and statues, we will give this subject more attention than we otherwise should do. There are three different ways of moulding a complicated statue. The first is to make the mould and the cast in parts, and screw or cement these parts together. This is an imperfect mode of forming statues, which never makes correct work, for it depends not only on the moulder, but also on the finisher who puts the parts of the statue together, how far the cast may be true to the original pattern. The parts of metal statues are screwed together; if plaster they are cemented together by plaster, and the joints smoothed. Statues of this kind are weak, nor can they be correct, as it is almost impossible to destroy all traces of the joints.

The second manner of forming statues is to cover the original with a thin coating of plaster, one-fourth to one-half of an inch thick, and paint this coat black,

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giving it a very thin film of charcoal-powder, strengthened with glue, and over this coating a thick coat of gypsum, two or three and more inches thick, according to the size of the pattern. This is laid on with the trowel. When this last coat is sufficiently dry to admit working at it, the cope is divided by black chalk into so many parts as are necessary to secure the separation of the cope from the pattern. The moulder of course is to be well acquainted with the pattern, or he could not with any certainty mark the parting-lines on the cope, having no means of ascertaining and tracing the lines on the pattern. To make this operation less difficult, a part of the pattern may be left uncovered, say the back (of a statue); this makes the tracing of the partings more safe. The omitted part is covered in a second operation, where the joining is formed by that line, and those parts of the cope which enclosed the covered space. The partings are effected by cutting down with a chisel or saw through the cope to the black stratum, and breaking the first covering of the pattern. The black paint forms here a uniform stratum interlining the cope; it gives warning to the operator to stop cutting, for the pattern is near. This mode of operating is easy and safe, as it makes a good and correct mould; but the broken edges which form

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the parting are very soon injured, and show unsightly joints on the casts. For plaster this method is imperfect, because it does not make many good casts. One cast may be made very correctly, but the following casts are not certain. The parts of the mould are held together by winding tape or twine around the mould.

The third plan of making a plaster mould is tedious and slow, but is the safest and most correct, and by good treatment of the mould may admit of sixty and more castings being made in it. The manner of forming such a mould is the following, which, with unimportant modifications, is practised in making moulds for metal casts. The surface of the pattern is marked by a lead pencil with such divisions as will secure the lifting of that part of the mould from off the pattern, as is enclosed by such marks. The operation of making the mould commences on a convenient place, by enclosing one division with fine plastic clay, and giving the borders towards the enclosed space that form which will cause the plaster to have the shape desired for that particular spot. The space enclosed by the clay is then filled by plaster, and when the latter is settled, and so far

dried as to admit its removal, the clay enclosure is first removed. This leaves a part of the mould to

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be made, or the plaster cast standing. This cast may be one, two, or three inches thick, according to circumstances, it being the object to equalize the surface of the mould, so as to have less abrupt reliefs. This first part of the mould is taken off the pattern, and the edges cut smooth by a knife. The taper of the edges is so calculated as to form the joints of an arch, so that when all parts of the mould are laid together without the pattern, no part of it can move or fall off from the others. To secure the relations of the parts of the mould still more perfectly, each part is provided with warts in the joints, fitting into opposite hollows of the next part. These warts are made with the point of a knife, by turning it backward and forward, and are set in the middle of the joints, or in such places as are considered more convenient than the middle. When the first part is dressed, it is again put in its place, and one side of it joined by clay enclosures. If the space now to be covered is square, the plaster will form one side of it, and the three other sides are formed with clay. This second space is again filled by plaster, and it forms part No. 2 of the mould. One side of No. 2 fits to one side of No. 1, and three are to be dressed and provided with hollows for warts. In this way the whole pattern is covered

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with small parts of the mould, which in many cases require fifty or more cores or parts. The last part of course is cast without any clay to form the enclosure, and is generally without warts to form the starting point in separating the mould. When the pattern is perfectly covered with this mould, the surface of the mould is dressed and cut smooth, to remove all sharp angles and abrupt reliefs. Over this first cope is made a second cope, but the first ought to be in such a condition that the second divides only into two, or at most into three parts. The divisions of the first cope of course fit exactly into the second, and if there is any doubt or danger that one of the parts of the first cope would fall out from the others in turning the mould, that part is to be provided with a wire staple to which a string is fastened. This string passes through the second cope and is secured outside. The second cope may also be provided with warts which fit in corresponding holes in the first cope, if found necessary, which, however, is not often the case. The whole mould, forming a comparatively heavy mass of plaster, is held together as in other cases by means of tape.

Large Plaster Castings are made hollow. This is done by casting first a small quantity of fine plaster in the mould, and in turning, the mould is led into

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all parts of it, and gives a thin covering to the whole face of the mould. A second cast of coarse plaster follows the first soon after, and this is equally distributed over the mould. A succession of such casts will give any thickness desired. Parts which require extra strength are laid on by hand or the trowel. Statues and busts generally require no cast-gate, because they are open below and are cast from that side.

Patterns and moulds in which plaster casts are to be made, are coated with a film of oil or soap; but valuable pieces of art, as marble statues or busts, do not admit of oil or soap without injury, and these means cannot be employed. In such cases the pattern is covered by tea-chest-tin or tin foil, but so as not to show the joints of the foil. The tin-foil is pressed on by a cloth-brush in such a manner as to secure the perfectly close covering in the undulations.

The face of a living or dead person may be copied in plaster by making a plaster cast over the face. The limits of the mask are marked by laying a wet cloth around the face. The hair and eyebrows are covered by pasting some tin-foil over them. Living persons are to have two paper or tin-plate pipes in the nose, to admit of breathing while the plaster is put on the face. Such

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masks are generally used as patterns for making busts of those persons from whom they are taken. The hair, ears, and the back part of the head, are to be supplied by the artist.

Sulphur is, next to plaster of paris, the most valuable material for sharp castings; but its application is limited to very small castings, on account of its brittleness. It can be cast over metals and many other materials without oil, and gives for these reasons very sharp impressions. Sulphur may be cast over a coin by surrounding the coin with a ring

of paper; the melted sulphur will not kindle the paper if it has the proper heat. In melting sulphur for casting, it is not to be overheated; at first heat it melts to a transparent clear fluid, and that is the time to cast it. More heat transforms it into a pasty mass, which cannot be used. The kindling of the sulphur should be prevented, by all means, for it will impart a dirty gray colour to the sulphur. Sulphur may be mixed with foreign matter to augment its strength. One part of plaster of paris, and two of sulphur, improve the tenacity of sulphur without diminishing its capacity for fine impression. Next to the above, fine Spanish brown, fine chalk, or clay in powder, may be mixed with it. Three parts

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of sulphur, and one of silver, is a good composition for sharp and durable impressions.

Wax in its pure state, as well as mixed with other matter, is a useful material for castings, but it shrinks considerably. It requires skill not to cast it too warm, or too cold. In the first case its castings will be defaced, in the latter they will not take sharp impressions. Wax may be mixed and successfully used with plumbago, cinnabar, white-lead, plaster of paris, and other substances. The mould wherein wax is to be cast, is to be very cold or wet, if the material admits of the absorption of moisture. When the face of the mould is covered by a thin coating of wax, the surplus fluid wax may be cast back into the ladle. A thin cast will not shrink so much as a thick cast.

Sealing-wax, isinglass, and glue, are also materials for making casts of, and are frequently used for small articles. There is one composition to which we have to allude more particularly; it is a composition used in making elastic moulds, for casting in plaster of paris—eight parts of glue, four parts of molasses, mixed and boiled together, and to this gradually added one part of varnish or boiled linseed-oil. This mass is cast hot over a pattern, and when cooled may be easily removed. It forms a gelatinous

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mass, and makes an excellent mould for plaster casts, having the great advantage of admitting of under-carving the pattern. Such a mould will not make more than six or eight sharp casts; but as the making of the mould is no object, it is the cheapest and quickest way of forming a mould for casting plaster in.

Alum cautiously melted, so as not to expel its water of crystallization, will assume a very fluid appearance, and may be cast in small moulds with success. Thirty parts of alum and one of saltpetre is still better; it makes opaque castings of a beautiful white. Five parts of alum and one of common salt melted together, makes transparent sharp castings. Melted saltpetre by itself, may be cast in hot metallic moulds, and makes castings of a fine alabaster appearance.

Moulding Natural Objects.—A mould over an object of nature, as over a small animal, a flower, or leaves, may be made in the following way. The dead animal, say a fly, or a bug of any kind, is put with its feet upon a ring of wax, so as to place the feet and everything else in such a position as we want it in the cast. This wax ring will form the channel or gate for the fluid metal. The object—animal or leaf—is painted with a very thin solution

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of gum-shellac in alcohol; and, after being dried, is placed in a small pasteboard box, and so fixed by means of small wires as to secure it in a permanent position. These wires, after being withdrawn, form air channels through the mould. A small tapered pin of wood is fastened in some convenient place for making a cast-gate. A mixture of three parts of fine plaster of paris, and one part of fine brick-dust, formed by an adequate amount of water, to which a little alum and an equal portion of sal-ammonia is added, into a thin pap, is now gently cast over the pattern, under continued shaking of the mould, or if that cannot be done because the pattern is too delicate, the pattern may be first covered by means of a fine camel's-hair brush, with a thin coating of the above mixture, and then the remainder cast over it. When this cast is hardened, the pasteboard enclosure is removed, and the cast gently but very strongly dried. After all the water is expelled, the mould is brought slowly and gradually to a cherry-red heat, to expel and burn all the animal and vegetable matter. A mould of pure plaster would not resist such a heat without falling to pieces, but an addition of brick-dust and alum gives it that resistance to heat which is needed. The sal-ammonia is added to facilitate the destruction of the natural pattern, the animal or plant. The

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cooling of the burnt mould is to be performed equally as slowly as the burning itself, to prevent its breaking. In the cooled mould some mercury is cast and gently shaken. By gradually adding more quicksilver, the remains of the pattern which may be left in the mould will float on the mercury, and may be brought out. By repeating the latter operation, all impurities may be effectually removed. Before casting any metal in this mould it ought to be heated to a certain degree, which degree will depend in some measure on the mass of the pattern, and the metal to be cast in it. Very thin fine patterns, and metals which congeal quickly, require a hotter mould than the reverse qualities. Silver is the best qualified for such casts: after this, type metal, tin-solder, and fusible alloys. A cast made in this way may be prepared to form a pattern for the current business of the foundry. If the mould has been hot and the metal also, the casts are generally so perfect as to show the finest nerves of the pattern. Larger objects may be moulded quite as successfully as small ones, but it requires more experience to succeed as well.

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CHAPTER II.

FOUNDING.

MELTING OF METALS.

Iron.—It is impossible to qualify the various kinds of pig-iron brought into the market, by local terms and marks. It would, after all, not be of any use, because the produce of one and the same furnace may change in one week's time from No. 1 iron to No. 2 or even No. 3, which certainly makes a great difference in its application in the foundry. There are, however, distinctions in the quality of iron caused by the ore, or by the fuel which has been used in its manufacture, as charcoal or anthracite; as well as by manipulation. We will allude to these local and practical differences when pointing out the specific qualities of metal for certain purposes, and confine our demonstrations at present to general remarks. Taking no notice of the difference between charcoal, anthracite, and coke or stone-coal iron, we have three distinct qualities, known as No. 1, No. 2, and No. 3 iron.

No. 1, *or Dark Gray Pig-Iron*, is the foundry iron.

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This pig-iron is, if anthracite and charcoal, mostly of a coarse-grained, apparently crystalline fracture. There are, however, no crystals; the form of the fracture is an aggregation of leaves. Iron, and the black graphite with which it is intermixed, appear to assume the same crystal form; they are so closely united that no distinction can be made of the difference in the form of the crystals, if there is any. Coke-pig, No. 1 stone-coal iron, and hot-blast iron, are generally finer in the grain than the above-mentioned qualities. Pennsylvania anthracite pig No. 1, and Pittsburgh or Hanging-Rock No. 1, are generally very coarse and black in the grain fracture. Charcoal iron No. 1 from the Eastern States, Maryland, Allegheny river, and Ohio river, Tennessee and Kentucky, is generally hot-blast, and finer in the grain than the above. Scottish pig, is of a fine-grained fracture.

The pig-iron of this class is soft, and often tender: most of our own manufactured iron is strong. It melts very fluid, and cools very slowly, which qualifies it particularly for castings. This iron, if very gray, may be remelted once or twice, but the fine-grained kinds, and those which contain less carbon, or are exposed to too much fresh air in melting, turn into the following, or

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No. 2 *Iron.*—This contains less carbon than the above, is more gray in appearance, and of a finer grain. If approaching near to No. 1, it is the best foundry iron, for it is stronger than No. 1. If this iron assumes a more gray colour, it is not qualified for small castings, but is very excellent for large castings in dry moulds. It melts fluid, fills the mould well, makes less sullage than No. 1, and does not burn the mould so much as the above. It is tenacious, may be filed, turned, planed, and polished; it is close, and more certain to be free from impurities than No. 1.

No. 3, is white pig-iron. By remelting No. 1 and No. 2 under the influence of a liberal access of air, they will be converted into No. 3. This iron is white, and most of it of a bright crystalline fracture. It is of no use in the foundry.

The quality of foundry-pig in our Atlantic cities, also in Pittsburgh, Cincinnati, and other cities along the western rivers, is no doubt of such perfection that

there is no difficulty in making any quality and kind of castings in any of these places. There is hardly a limit to the variety of good foundry-pig in these markets. Some general remarks on the characteristics of pig-iron for foundry purposes will however be in place.

Dark Gray pig-iron, with large leaves of plumbago,

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is qualified for small castings, as hollow-ware and small machinery, but would not answer so well for heavy castings, which require strength. There are, however, exceptions to this rule. The pig-iron most useful for the very finest kind of castings, is to be fine-grained. Coarse-grained pig will not fill a fine mould, at least will give but dull impressions. If pig-iron contains a little phosphorus, it may be fine-grained and still be an excellent foundry iron, particularly for hollow-ware and stoves. Hollow-ware made of gray iron which contains much carbon or plumbago, is liable to cooking black; this evil is not so apparent where pig-iron of lighter colour, containing a little phosphorus, is used. Black iron is not qualified for large or heavy castings, as it is generally too spongy.

Hot-blast and cold-blast iron are simultaneously brought into the market, and the former is frequently sold for the latter. For foundry-pig it makes but little difference whether made with hot or cold-blast, and we may say, generally speaking, that hot-blast iron is preferable to cold-blast, because the grain is finer, the iron more uniform, and it runs more fluid than the latter. In anthracite and stone-coal pig there is but one kind, and that is hot-blast. A difference is often found in charcoal-pig, but then it

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is generally marked cold or hot-blast, when made at an establishment of reputation. To distinguish cold-blast from hot-blast iron, is almost impossible. The only permanent difference is a finer grain in hot than in cold-blast, provided the amount of carbon in both kinds of iron is the same, and the iron is made from the same kind of ore. This mark of distinction is, however, very doubtful, and may lead to errors. A more certain criterion is the colour and lustre of the pig, in a fresh fracture. Provided all other things—as ore, coal, manufacture—are equal, the fracture of hot-blast iron is duller than that of cold-blast; the latter shows more life than the first, and a freshness of colour, which is not so clearly expressed in hot-blast iron. Hot-blast iron is frequently found to be of a fine grain, interspersed with clusters of coarse grains, the fine parts of a dull appearance. These distinctions of colour are a safer criterion than the size of the grain, but both together may afford some means of distinguishing between the two. It would be of little value to know whether a specimen of iron was smelted by hot or by cold-blast; but as the cold-blast iron contains less carbon and impurities, if of the same colour as hot-blast, and as a mixture of cold-blast and hot-blast iron

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makes the strongest castings, it is desirable to have the two qualities separated.

The mixing of different kinds of iron is an object of considerable interest, and all foundries ought to make their own experiments to ascertain the strength of the material they are working. In making ornamental casts, strength is of secondary consideration, but in machinery, and beams for architecture, it is of the first importance. In foundries where machinery is cast, or water pipes or beams for bridges or architecture, there should be means of testing the strength of their cast-iron. The safest and best way of doing this, is to have a standard pattern, say a prism of two feet long, one inch thick, and two inches wide. This pattern is to be moulded in a particular flask, with uniformly dry sand, and cast inclined at a particular degree. The mixture of iron is made in a crucible melted in an air furnace. This trial or proof-bar is fastened with one end in a vice, and at the other end a platform is suspended, upon which so much weight is piled as to break the bar. In the mean time the deviation from the straight line, or from its original position, is measured. In this way the relative strength as well as the degree of elasticity may be measured, and the relations of the strength of one

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mixture of iron to the other, decided on with great certainty. This is not to be considered a scientific experiment—it is a mere matter of local, practical interest. Under all conditions, a mixture of iron melted together is stronger than the average strength of the whole, each measured by itself. Hot-blast iron has the advantage of being of a more uniform

texture than cold-blast iron, and being more firmly united with carbon. A mixture of hot-blast iron may therefore be made which supersedes any cold-blast iron, in respect to strength, provided hot and cold-blast are made of the same materials, and in the same manufactory. The kinds of pig-iron which are to be mixed together to form the strongest compound, are difficult to decide upon here. It depends very much upon the experience of the founder, and also on circumstances which are beyond his control. Few of our blast-furnaces have yet settled upon a definite quality and mixture of ore, shape of the furnace, and other matters which influence the quality of the iron smelted. So long as such matters are not definitely settled, no brand of pig-iron can be depended upon for its quality. In purchasing, the buyer is to depend upon his own experience and chance. If pig-iron is too gray, or too spongy, it may be improved by adding No. 3 186 iron, or in most cases scraps of old castings are preferable. Very black-gray iron will bear an addition of 30 per cent. of No. 3 pig or scrap. Iron which contains too little carbon is successfully improved by adding No. 1 until the wished-for strength and texture are obtained. In all cases iron from different furnaces ought to be mixed together, and if there is any possibility of obtaining iron from different localities and different ores, it is to be preferred. An anthracite pig of the Schuylkill region is stronger if some Scottish pig is added to it; charcoal iron from the State of New York, or from Baltimore, is still better for that purpose. The superior qualities of Ohio iron may be made still stronger by mixing it with some kinds of Allegheny or Tennessee iron. In all cases, however, it is better to mix No. 1 of one kind with No. 2 or No. 3, or scraps of another kind. And if possible, mix cold-blast with hot-blast iron. The strength of iron depends a great deal upon the mode of melting it, but we shall speak of this hereafter.

Besides the consideration of strength, economy in many instances decides the qualities of iron to be worked in a foundry. True economy, however, is that which secures the best castings, and gives most security in avoiding scraps. A mixture which 187 makes a close and compact soft gray iron, is the best in all these instances.

An important influence in mixing iron is due to the kind of casting, its size, and its purposes. Iron of which beams and rolls for iron mills are cast would make poor hollow-ware or ornaments, and iron which makes sharp impressions on small articles, is generally not qualified for heavy articles. Heavy machinery is best made of No. 2 anthracite iron, or a mixture of No. 1 anthracite, and No. 3 charcoal. The variety of anthracite iron is not indifferent in this question, for there is some very weak, also some very superior iron. Hanging Rock pig of good quality is no doubt the strongest cast iron in the world, and it would be an advantage to western enterprise if scientific experiments were made to decide the value in numbers of its superiority over other pig-iron. Small castings and ornamental castings require a fusible iron which coagulates soon and is not too gray, so as to assume sharp impressions. Iron containing a little phosphorus, being a little cold-short, is preferable for these purposes; that smelted of bog-ores is the proper kind for small castings. Railings and ornaments which require strength to resist sudden jerks, are to be cast of a fine-grained, pure iron, free from phosphorus or 188 any such admixture. Chilled rollers or chilled wheels require a very strong No. 2 iron, but it is preferable to make No. 2 of No. 1 and scraps or No. 3 charcoal. In hard rollers a little phosphorus does no harm, but in wheels any pig-iron made of bog-ore is to be rejected.

The kind of mould in which iron is cast has a decided influence upon the strength of the cast. Machine frames, beams, rollers, and all castings which require strength, are to be cast in dry sand or loam, for green sand will cool the cast too rapidly, and cause it to chill, or become hard and brittle. Castings which ought to have a good smooth surface, to be perfect, require a green-sand mould. A mould well dusted by blackening will make smooth and good-looking castings. Thin castings, that is, castings which soon cool, are always more smooth than those where heavy masses of metal are confined to a small space. Castings which require strength are to be cast upright, or at least inclined, having the cast-gate to enter from below, and a flow-gate at the

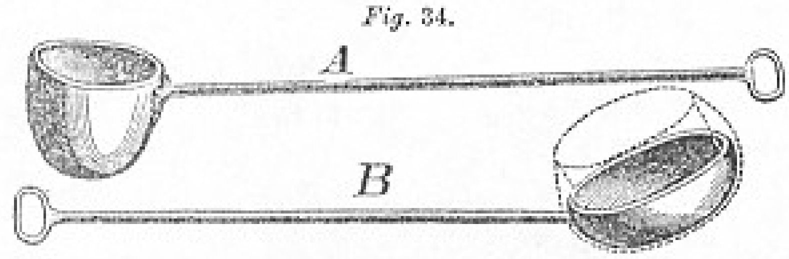
highest part of the mould.

MELTING OF CAST IRON.

Iron in the Blast-Furnace.—Iron is in some few instances used directly from the blast-furnace to make castings of. It is done in those places where 189 fusible ores, as bog-ores and hematites, are smelted by charcoal in small blast-furnaces. There are but few establishments where this is practised; some are along the Atlantic sea-coast, a few in the interior of the Eastern States, and but very few in the Western States. The whole business done in this way does not amount to much. There is really no advantage in casting directly from the blast-furnace, for the iron is never of such uniform quality as to secure good castings. It is on the whole disadvantageous, and more expensive than remelting the cast iron, and giving it a proper quality by mixing it with other kinds of iron. There are, however, instances where casting from the blast-furnace is not only excusable but necessary. Where bog-ores are smelted which make cold-short iron, it is advisable to transform the iron directly from the blast-furnace into castings. Iron, cold-short of phosphorus, is generally not used in forges, and it has too little carbon to admit of remelting. There is hardly any other way left but to make castings of such iron. It is not qualified, however, for machine frames, or castings which ought to be strong. The only and best purpose it is adapted to, is for casting hollow-ware and stoves; it will form fine and sharp castings, and cooking pots made of such cold-short iron cannot be surpassed in quality. 190 It makes enamel superfluous. The usual way of casting from the blast-furnace is to prepare a stopper of slag, just fitting in below the timp of the furnace. This stopper will separate the interior slag and that in the forehearth of the furnace, provided the stopper reaches down into the liquid iron, the blast at the furnace of course being stopped. The surface of the iron in the forehearth, after being cleared of its slag, is clear and will keep so, provided the stopper is thick enough and remains in its place. The iron is dipped, with dippers or ladles of cast or wrought iron, as far as this can be accomplished; after this the stopper is removed, the cinder from the back of the hearth drawn forward, and the furnace put into blast again. A more perfect way of taking iron from the blast-furnace is to make a dip-pool in one of the tuyere arches, provided for that purpose, and where there is no blast-pipe. If the back arch, opposite the work arch, is chosen, the moulding and casting may be carried on very conveniently, without coming in contact with the smelter and his operations. A hole like a tap-hole is here pierced through the back stone, or one of the flanks of the hearth, down at the bottom or near the bottom, and around this hole a round basin is walled up in fire-brick, and well secu- 191 red in its place by iron binders. This basin need not be larger than to admit a ladle. The hole which puts this basin in connexion with the interior of the furnace-hearth is to be of such a height over the bottom of the hearth as to leave a cover of fluid iron always on it. This pool is filled with some burning charcoal to keep it warm, and as the iron rises in the hearth it will rise in the pool, from which the moulders may dip and take it at any time they choose. When the pool is once thoroughly hot, it requires no charcoal to keep it so.

In figure 34 are represented two ladles. The one is made of cast iron, the other of wrought iron. The latter is preferable for dipping, because there is less danger of its being burned. These ladles are covered with a thin coating of loam, indicated by the dotted lines. A, the cast-iron ladle, receives a

Fig. 34.



strong washing of loam; B, the wrought-iron one, forms merely the bottom to a clay ladle. The well worked clay is set upon the edge of the ladle and forms a 192 dipper as large as the moulder may choose it to have. The clay is put on every day, or every cast, anew, and it is to be well burned before it is dipped into the iron, or dangerous explosions may be the consequence of such neglect.

Melting Iron in Crucibles.—This mode of melting is not now practised, but it was formerly in use, and is still so for some particular purposes. All the fine iron castings, as trinkets and similar objects, are cast

from crucibles. The iron melted in a crucible is very quiet, and generally not so hot as to burn the sand; it makes smoother and more solid castings than iron melted in a different way. Compositions of iron may be made and melted in a crucible, which would not retain their quality in any other mode of melting. The melting in crucibles is expensive, because of the cost of crucibles, coal, and labour; but there are instances where these are secondary considerations. A good black-lead crucible ought to last ten or twelve heats of fifty pounds each, and as the plumbago is found in large masses, is cheap, and coal is no object, it may be found a profitable way of making small castings for carpenters and knife-manufacturers. The air furnace for melting iron in crucibles is the same as that used for melting brass, bronze, and similar metals; it is represented

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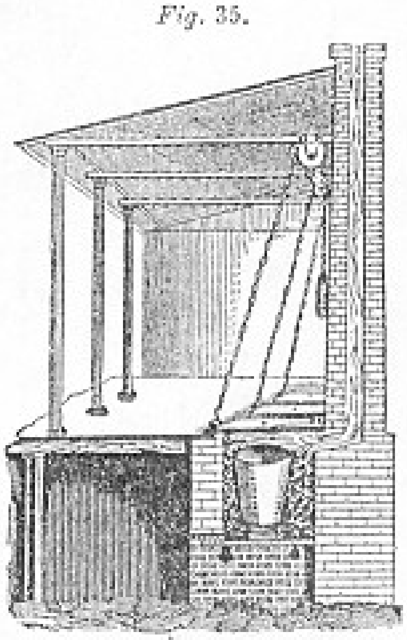
in figure 35. This figure explains itself; the furnace is put below ground to a chimney whose lower interior part is built of fire-brick, as well as the interior of the furnace. The furnace is covered by

Fig. 35.



a cast-iron plate, a kind of trap-door, which is balanced by a weight and an iron chain passing over a roller; or in any other convenient way. The grate bars are simply square inch-rods of wrought or cast iron, and may be pulled out one after the other, to drop coal and cinders at once, or to clean the furnace. The crucible is set upon a piece of fire-brick which rests upon the grate. The bottom of a broken crucible inverted, is preferable to brick as a

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sole-piece. The crucible is to be raised from three to six inches above the grate, according to the fuel employed. Charcoal requires the highest elevation, coke less, and anthracite the least. The best form for the furnace pit is a square: the four corners resulting from this arrangement are very useful to charge fresh fuel in, which, if the furnace is round, requires more room than can be advantageously given. The crucibles are to be perfectly dry before they are put in the furnace; the least moisture will destroy a crucible if not removed before exposing it to the heat of a furnace. The iron, or other metal, is to be heated before it is charged, and the fuel must be dry and warm, before being laid around the crucible. The mode of operation is simply as follows. The grate is put in the furnace, and upon it the brick-bat or broken crucible, which is to form the pedestal—sole-piece—of the crucible. The fire is then kindled and made to burn briskly, while the crucible and metal are heated on the door-plate. When the interior of the furnace is red hot, and the fuel burnt as low down as the sole-piece in the centre, the empty crucible is put upon it, and then the metal in pieces gradually charged, until the crucible is filled. When the metal is partially melted, there will be room for more, which is

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piled upon the other, and the whole covered with a few scraps of glass, which, when melted, will form a film on the surface of the iron to protect it against the access of air. A moveable cover of crucible clay will serve the same purpose as glass, but it is more troublesome than the latter. In fifteen minutes the first portions of iron are melted, and the addition may be charged. In three-quarters of an hour the whole of the iron is melted, if properly attended to, and is ready for casting. The fuel is always kept as high as the crucible, and from the first somewhat higher, but the last fuel is given when the metal is not entirely melted, so as not to cool the fire after that by fresh fuel. The fuel is burned down at last so far as to free the crucible of it to a certain depth, and to admit the access of the tongs for removing the crucible. The tongs are made of strong bars of iron, three-quarters or seven eighths square, and and from four to six feet long, one end provided with prongs bent in such a manner as to form a basket to catch the crucible as low down as possible. These tongs are suspended in a chain and a crane,

or, the chain very long and fastened to the ceiling of the building. The first operation is to move the crucible from the fire and at the same time put it into a pot-handle for casting. This handle is the
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same as those on iron pots, to be described hereafter. It is to be heated previously, to prevent injury by cold to the crucible. Two men carry the crucible to the mould and cast, and return the crucible directly to the furnace, into which it is set without delay. Gradual charges of metal are now given, and the melting goes on as before. In case no more metal is to be melted, the crucible is put inversely in the fire to let it cool slowly. In all instances a hot crucible is to be put inversely in case it is set down anywhere; the heated bottom of a crucible never is to come in contact with anything colder than itself. Four or more furnaces may be put at one stack, and as many may be put in a row as is considered necessary. Charcoal may be used in these furnaces, coke is better, but the best fuel is anthracite coal. The danger from the latter is its being too severe upon the crucibles, on account of the great heat it evolves.

Melting in Reverberatory Furnaces.—The best melting furnaces on the large scale are the reverberatories. They are in use in some foundries where the proprietors are desirous of making good castings, but are in a great measure replaced by cupola furnaces. The reverberatory is next to the crucible in making good foundry metal: it gives uniformity
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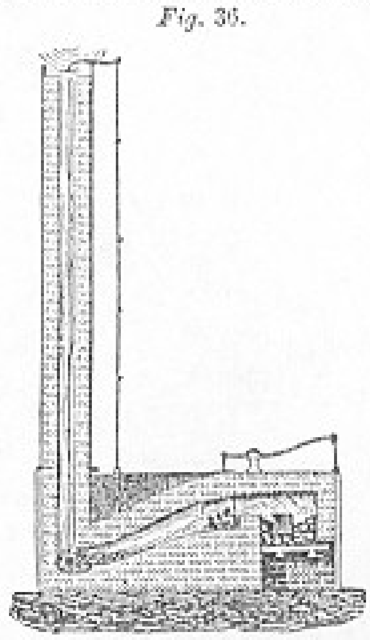
to the various qualities of pig-iron charged, and the melted iron is quite free from air-holes, and flows like lead into the mould. All founders and engineers agree that castings made from the reverberatory are stronger

Fig. 36.



than those from the cupola, if made of the same iron. In figure 36 a reverberatory furnace is represented in section. The whole interior is constructed of fire-bricks, and cemented by fire-proof clay. The enclosure is generally made of cast-iron plates, but we also find furnaces which are enclosed in common bricks, bound together by iron cross ties or binders. The stack is generally 40 and more feet high, even as high as 80 feet; but there is no need of that, as 40
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feet makes sufficient draft. The grate is $3\frac{1}{2}$ feet long and from 5 to 6 feet wide, or as wide as the interior of the furnace. The hearth is from 5 to 8 feet long and equally as wide; it slopes gradually towards the chimney, and forms a basin for the accumulation of the melted metal. The fire-bridge, which separates the fireplace from the hearth, is from 10 to 15 inches high, according to the capacity of the furnace. One side of the furnace is provided with a large iron sliding-door for charging iron and repairing the hearth; this door is at the highest part of the hearth, near the fire-bridge. In the lowest part of the hearth, in the centre of the basin, is the tap-hole. This may be at one side of the furnace, or behind the stack at the flue. A damper on the top of the stack is a useful fixture to regulate the draft. A furnace of this kind is to be very thick in the walls, so as to be as bad a conductor of heat as possible. Too much attention cannot be paid to close joints in the brickwork; open crevices which admit air are to be carefully stopped up, or the iron is liable to a loss of carbon, and will make, in consequence, hard and brittle castings. There are various forms of reverberatory furnaces in use, but the most general is that represented above. There are furnaces with double arches; that is, where iron is
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melted at the fire and at the flue-bridge, and the melted metal concentrates in the centre of the hearth where the arch is drawn down. There are also furnaces where the cold pig is charged in the centre of the basin, which is the centre of the hearth; but none of all these various forms is superior to the above. The pig-iron is here charged behind the fire-bridge, and, as it melts, flows down into the basin. The impure matter adhering to the pig-iron, and which does not melt, as sand and coal, will remain behind the bridge, and may be removed

at any time after the heat. In this way, the melted iron is not in contact with any impurities which can injure it. The heat of the furnace is generally greatest near the flue, and the melted metal is in this case exposed to the strongest heat of the furnace. The manipulation at this furnace is very simple. When a cast is to be made at a certain time, the furnace is heated some five or six hours before, and a brisk fire kept all the time; for it will take from three to four hours before the furnace is sufficiently hot to charge iron. The furnace is to be white hot before pig-iron is charged. The large door is then opened and the pig-iron charged, one ton or more at once; in fact, as much iron as is required to make the cast desired; for it is not con-

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sidered advantageous to charge cold iron while a part is already melted. All the iron contained in a liquid form in the basin, is to be tapped before any fresh pig can be charged. When all the iron contained in the furnace is melted, the tap-hole is opened with a sharp crowbar, and the liquid iron either let into pots or directly into the mould. The tap-hole is stopped with damp sand, or a mixture of loam and coal-dust. When the furnace is charged with iron, all the crevices and joints at the door and in the brick-work are to be cautiously stopped with moist loam, to prevent the access of any air upon the hearth. The firegrate is also to be well attended to, and kept well filled with coal, but not too high, so as to impair the draft of air through the fuel. The grate should be kept free from clinkers, and the formation of holes where the air could pass through unburnt, is to be prevented.

The reverberatory furnace is not only used for melting iron, but is also employed for the melting of large quantities of brass, bronze, tin, lead, and other alloys and metals. Large bells, statues, machine-frames, and similar objects, are cast from the reverberatory furnace. All metals, except very gray, fusible iron, which may be cast from a pot, are to be run in dry sand-ditches, directly from the furnace into the

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mould. The best fuel for the reverberatory is bituminous coal. Hard coal or coke may be used, but is not so well adapted as the first. The disqualification of the latter arises partly from their incombustible nature, but chiefly on account of the mass of fine ashes which is carried over from the fireplace to the hearth, covering the melted iron and preventing its absorption of heat. This evil is more apparent in the use of anthracite than of coke. Wood, particularly green wood, is not at all qualified for use in the reverberatory; if no mineral coal can be obtained, *charcoal is to be substituted for it.* For the general character and quality of castings, it is to be regretted that the reverberatory furnace for the melting of iron is fast disappearing. Machine-frames of large size, rollers for iron mills, and even chilled rolls, are cast from the cupola. Machine, engine, and iron manufacturers, bridge builders, and architects, ought to insist on having their castings done from iron melted in the reverberatory furnace. Casts from the blast-furnace directly, are the very weakest, and, next to it, ranges the iron of the cupola. The reverberatory and the crucible make the strongest, closest, and safest castings.

The Cupola, has the advantage of melting iron cheaper than any other furnace. Besides this, it is a

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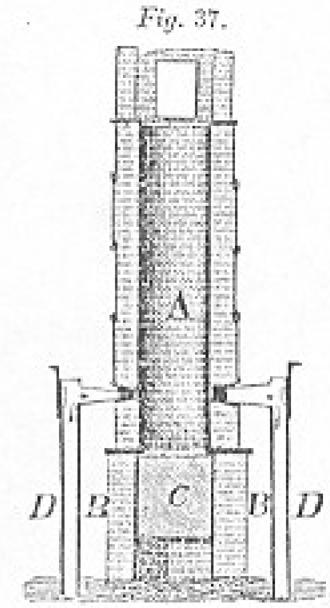
very convenient apparatus, because a small amount of iron, say fifty pounds, or as large a quantity as five or six tons, may be melted in a short time, with comparatively a small amount of fuel, and in furnaces showing but little difference in size as well as form. In casting small objects, as hollow-ware, agricultural implements, architectural ornaments, and similar forms, and, in fact, in all cases where the strength of the metal is a secondary consideration, there is no question but the cupola is the best form of melting-furnace. There is a great variety in the form of cupolas, but only in minor points; all cupolas generally agree with the form represented

Fig. 37.



in Fig. 37. In A, a section of the cupola-furnace 203 is shown, with another section to represent the sloping bottom. It consists of a cylindrical cloak or enclosure of boiler-plate or cast-iron, of from three to six feet in diameter. This rests upon two brick walls, B B, which are overlaid by a square iron plate, having a round orifice as large as the interior of the furnace. This orifice is closed when the furnace is in operation, by an iron door, C, shut and held close by means of an iron bar propped against it. When the furnace is going out of blast, and is to be emptied of its contents, this door is let down, and with it the slag and hot coal of the interior will drop. The inside of the furnace is lined with fire-brick, or it may be lined with a mixture of fire-clay and river-sand, firmly rammed in and gently dried. A good lining for a cupola may be made of turnpike-mud, where the road is macadamised with flint or hard sand-stone; but, where iron or lime is contained to some extent in such mud, it should be rejected. Some cupolas are but four feet in height, while others are made from eight to nine feet high. We consider five feet as too great a height; there is no other advantage in it than having a larger body of fuel at once on fire, which may be effected to more advantage by a greater diameter. Low furnaces, even as low as three feet, use less fuel than the higher 204 ones. The width of cupolas is quite as variable as the height; there are furnaces of eighteen inches in diameter, and some are four feet. With charcoal, eighteen inches wide and one tuyere will make hot iron, but coke requires at least twenty-four inches and two tuyeres, and anthracite thirty inches or more to produce the same result. A cupola is generally overbuilt by a spacious chimney, to lead the hot gases over the roof of the building; but a sheet-iron pipe will serve quite as well as a brick chimney. The lining of a cupola should be at least nine inches thick, and may be still thicker, if made of fire-brick. These bricks are to be laid in fire-clay mortar, a mixture of refractory sand, and as much fire-clay as is needed to hold the sand together. The tuyeres are generally from ten to fifteen inches above the iron bottom of the furnace, and are simply round orifices, of the size of the nozzle, cut through the in-wall. For small furnaces, but one tuyere is used at the back of the furnace; for larger furnaces, at least two tuyeres are needed; and for still larger, and particularly hard-coal furnaces, we frequently find six or eight tuyeres, cut in the same horizontal plane, in one furnace. If the diameter of the furnace is large, the tuyeres are multiplied, in order to generate

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a uniform heat at all points in the furnace. Where a large quantity of iron is to be melted at once, tuyeres are cut one above the other; if the melted iron is raised to the height of the lowest tuyeres, these are stopped with fire-clay, and the next above opened, and if the iron is raised to the second, it is also stopped up, and the next higher put in operation. This process is continued until all the iron required for the cast is in the furnace. The vertical distance between the tuyeres is generally six inches. The nozzles of the tuyeres are simply sheet-iron conical pipes, of from three to five inches in width at the narrowest part. The conducting-pipe from the fan to the furnace ought to be at least twice the diameter of the nozzle, or four times as large as the area of all the nozzles. Where more than two tuyeres are used in one furnace, we frequently see a square cast-iron pipe surrounding the furnace; in this pipe are as many orifices, directed towards the centre of the furnace, as there are tuyeres; the nozzles are attached to these orifices.

The operation in a cupola is simple. If iron is to be melted, the first thing to be done, is to lock the iron door at the bottom, then fill in a bottom of sand: moulding-sand is generally used in cases where but a small quantity of iron is to be melted. If a large

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quantity of melted metal is required, a more refractory sand is used. The fire is kindled by laying a few chips of wood on the bottom, and placing upon them some coke, stone-coal, charcoal, or anthracite. The fire is kindled through the tap-hole, which is at least six or eight inches wide. The tap-hole is left open to admit fresh air for promoting the combustion. The tuyeres are also left open. The furnace is now filled to its mouth with fuel, which is kept at a brisk combustion. It generally requires two or three hours to heat or prepare the furnace for blast, which is not put on until the flame

appears on the top of the fuel. When the furnace is thoroughly heated, the nozzles are laid in and the blast-machine is put in operation. Previous to this, however, the large tap-hole is stopped up with moulding-sand, or with a more fire-proof sand mixed with clay, leaving a small orifice at the bottom, which forms the tap-hole for the iron. This tap-hole is $1\frac{1}{2}$ or 2 inches wide, and is formed by placing a tapered round iron bar in the place where the hole is to be, ramming the sand tightly around it, and removing it as soon as the hole is filled up. The blast, when put on, will drive a flame through the small tap-hole as well as out of the top of the furnace. The small tap-hole is kept open to dry

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the fresh loam or sand more perfectly, and also to glaze the tap-hole so as to resist the abrading friction of the tapping-bar. The flame, also, helps to glaze the lining of the furnace, which is more or less injured after every smelting, and requires mending with fresh fire-clay. When the furnace is to hold a large quantity of metal, the large tap-hole is covered by an iron plate, which is fastened by wedges to the iron enclosure, leaving only the small tap-hole free. The iron is charged as soon as the lower parts of the furnace show a white heat, which is best known by the colour of the flame that issues from the tap-hole, it being at first a light blue, but, with increasing heat, assumes a whitish colour, and apparently a higher heat. In about ten minutes after charging the iron the melted metal appears at the tap-hole, which is now closed by a stopper made of loam, which is worked in the hand until it assumes a certain degree of tenacity; a round ball of it is then fastened on the end of a stick of wood, provided with a disc of iron, which, being previously wet, is then pressed into the tap-hole. A charge of iron never consists of less than two hundred pounds, and, in most cases, of four or five hundred pounds. Pig-iron is broken into pieces of from ten to fifteen inches in length before it is charged. From ten to

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twelve pounds of fuel are consumed and charged with every hundred pounds of iron in good furnaces. Small furnaces, and those which are driven slowly, use more fuel, and the amount often rises to twenty pounds of fuel to one hundred pounds of iron. Along with the charges of coal and iron, a little limestone, broken into two-inch pieces, or oyster shells, is charged, to about two, or three, and often five per cent. to the weight of the iron. Too much limestone, as well as too little, causes the iron to become white, lose some of its carbon, and in most cases, its strength and softness. The furnace should be kept full while in blast, or at least so long as iron is melted, by alternate charges of iron and coal. Coal is generally put on first, then iron, and on the top of these the limestone is laid. When all the iron needed for the occasion is melted, the charges are stopped. The blast, however, is urged on, until all the iron has been tapped. The sand bottom of the furnace is made sloping, so as to admit of discharging the last portions of the iron. A well-constructed cupola furnace will melt one ton of iron every hour; some furnaces as much as three tons per hour; small ones, frequently not more than half a ton in an hour. Most furnaces are wider at the bottom than at the top; they

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therefore work hotter than those with parallel sides, and also have the advantage of lasting longer, as the melted iron, which is apt to cut the fire-brick, does not run down along the brick. The taper to be given to a lining is dependent upon the size of the cupola; a large furnace will bear more taper than a narrow, or small furnace. If different kinds of iron are to be melted in the same heat, a thick layer of fuel is interposed between the various qualities, so as to admit of the extraction of all the iron which was first charged before the second appears at the bottom. In such cases, it is advisable to melt the gray iron, or that iron which is to make soft castings first, and the white or hard iron last. When as much iron is melted as is needed for filling one or more moulds, the clay plug of the tap-hole is pierced by a sharp, steel-pointed bar, and the metal run into pots, which are carried by hand or with a crane, or it is run directly into the mould by means of gutters moulded in the sand of the floor. Between each successive tapping of the iron, the tap-hole is closed, and more iron gathered. Where more iron than the furnace will hold is required for one cast, a portion of it is tapped into a large pot, which process may be carried so far, as to make castings of five or more tons from a small furnace.

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Pots in which iron is carried from the furnaces to the moulds are represented in figures 38 and 39.

Fig. 38.

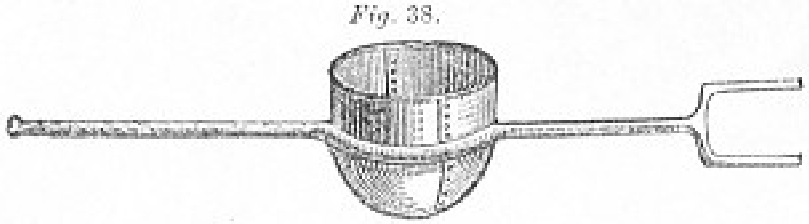
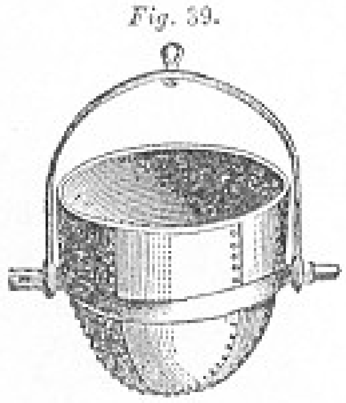


Fig. 39.



The first is generally of a capacity sufficient to hold from two to three hundred pounds of melted iron. It can be carried by three or more men; the forked part of the handle is used for tipping the pot, so as to pour the iron gradually into the mould. Figure 39 is designed to be raised by means of a crane, and emptied therefrom into the mould. The cupola or reverberatory at which such a pot is used, as well as the mould, should be within the sweep of the crane. Pots of this description are of various sizes; we

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find some which will hold five hundred pounds, and others will hold two tons and more. The swivels on such pots are generally strong, and their ends square, with a key-hole to fasten one or two forks to them, for the purpose of tilting the pot and pouring its contents into the mould. These pots are always made of boiler-plate, as it would be dangerous to make them of cast-iron. Before each cast, the pots receive a wash of strong clay-water, to prevent corrosion by the hot iron.

The foregoing are the most important means of melting metal; in the cupola, no metal but iron is melted. Copper, bronze, brass, German-silver, silver, gold, and the alloys of these metals, are either melted in crucibles, or, if large quantities are to be smelted, in the reverberatory furnace. The furnaces, crucibles, and other tools, are essentially the same for other metals as those described for melting iron. Slight variations in the form of melting apparatus are often advised, but there is no essential difference, no alteration in the principle. Fusible metals, such as lead, tin, zinc, antimony, and the alloys of those metals, may be melted in iron pots, kettles, crucibles, and iron ladles, and also in clay crucibles. The heat required to melt these metals is not so high as the melting-heat of iron.

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BLAST-MACHINES.

Formerly, cylinder blast-machines were used to supply the cupola with air for combustion, and in some few establishments they are still retained for fanning the furnaces; the impression being, that iron melted by cylinder blast is stronger and less injured than that melted by other blast-machines. There is no doubt that the cylinder blast is preferable to the blast generated in machines where water is in contact with the compressed air; in all other respects the impression is erroneous, as there is evidence sufficient to satisfy the most sceptical. In the present case, only, a blast is required for the cupola; in other furnaces it is not needed. To nourish a cupola, no better or more perfect blast can be generated than that made by the fan, or the centrifugal blast-machine. Practice has proved that the fan makes the cheapest blast, and also saves fuel; it has no deteriorating influence upon the iron, provided the quantity of blast sent into the furnace is sufficient to generate a strong heat. In figures 40 and 41, a common fan is represented. It is an iron box, consisting of two cast-iron sides, with a rim of sheet-iron between them. In the centre of the box is a hori-

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zontal shaft, with four fans or wings, which move with great rapidity, drawing in the air at the centres on each side, and driving it towards the periphery,

Fig. 40.

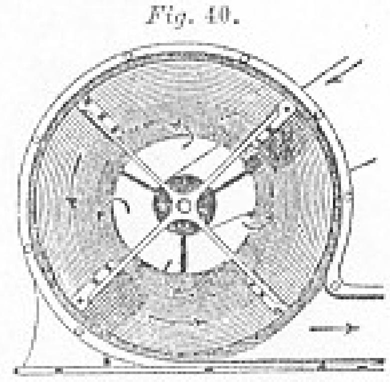
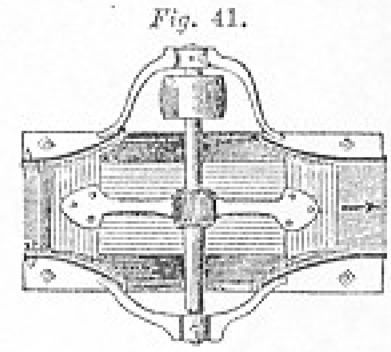


Fig. 41.



thus imparting to the particles of air a momentum, by the centrifugal motion, which presses them against

the circumference, and if there is any opening at the circumference, the air will escape with a speed proportionate to that pressure. These fans have been constructed of various sizes and forms; their depth is varied according to the quantity of air to be derived from them; the wings are from four to twenty-four inches wide; eight inches wide is sufficient to supply a well-sized cupola. The diameter is as various as the width of the fan, but it is generally admitted that three feet in diameter is the most profitable and practical size. The wings are often placed in the direction of the diameter, as is shown in the engraving; sometimes in an

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inclined position to the diameter; and also have been curved in a spiral line, but without any appreciable difference in effect. The latter form of the wings does not cause as much noise as the radial vanes. The chief object in constructing a fan is to form it so as to do the greatest amount of work. The case should be strong and solid, and for these reasons wood is not the proper material for its construction. The shaft and vanes are to be as light as possible; the shaft, of steel, hardened at both ends, where it runs in brass, steel, or cast-iron pans. The vanes of the fan are to be of thin sheet-iron or sheet-copper, and the arms to them of wrought iron. One of the most important conditions of a fan, is the equal weight, and the equal distance from each other of the vanes; and each arm supporting them is to be exactly of the same weight as the other. If these conditions are not complied with, the machine will shake, and soon be out of order. A mere adjustment of the axis, and the vanes attached to it, is not sufficient; it is absolutely necessary, for a good machine, that all the parts around the shaft should be of an equal thickness. In a fan of three feet diameter, the centre openings are generally one foot; in larger fans the openings are larger. Very large apertures will not answer; the air is conducted too quickly to

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the periphery of the vanes, and there is not sufficient time to impart to the particles the momentum requisite to produce a good effect.

The chief difficulty in constructing a fan is, in the close fitting of the vanes to the sides of the case. The latter cannot be made very straight without incurring much labour, and, on the other hand, it would be very difficult to adjust the axle so perfectly in the centre of the case as not to touch it, which, considering the great speed of the vanes, is almost impossible. It is also easily perceived that the loss in pressure is in the space between the vanes and the cast-iron sides of the case. To diminish this loss, fans are now constructed in which the vanes are covered on both sides with two concentric plane rings, so that the axle with the vanes, forms a hollow drum, open in the centre and at the periphery. The vanes are fastened to these two bottoms or rings, and also to the arms, radiating from the centre. The two bottoms move round with the axis, and parallel with, and close to the sides of the case. In the centre, where the air is drawn in, the case is turned perfectly round, as well as the rim on the centre of the bottoms; both fit closely, but do not touch each other. Where these join there is but from eight to twelve inches diameter, which may

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be kept tighter than the larger surface and circumference at the vanes. By these means the loss in pressure is greatly diminished, and it is an established fact that these fans require less power, and make stronger blast than fans of other descriptions. Fans of this construction are now most commonly used. The bottoms and vanes in these fans are made of thin sheet copper. The effect of a fan does not depend so much upon its size, as upon its speed and the size of the nozzle. It does not require large vanes to make strong blast; it is sufficient if the surface of each is one-and-a-half times the area of the nozzle, or, if there are more nozzles than one, of the sum of the areas of all the nozzles. More than four vanes in one fan are useless. In the conducting-pipes from the fan to the furnace, there is to be a throttle-valve at each nozzle to shut off the blast at each without disturbing the others. The speed of the axle of a fan is from seven to twelve hundred revolutions per minute. It is driven by a belt and pulley on one side of its axle. To melt a ton of iron in an hour's time, requires about seven hundred cubic feet of air per minute, or, by a three-foot fan, eighteen hundred revolutions, and two three-inch nozzles. Six horses

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power is needed to drive a fan with the above speed and size of nozzles.

Hot blast has been tried in various instances, but not with such results as to induce a continuance of it. In this instance, hot blast has no other advantage than a small saving of fuel, and as the fuel consumed is not to be considered expensive, the getting up of the apparatus, repair, and disturbances caused by it, amount to more than the gain of fuel.

Drying Stoves are simply brick chambers, one side of which is entirely open. Three sides are formed by a nine or twelve-inch brick wall. In one of the sides is a fire-place, which can be supplied with fuel from the outside of the stove, and may be shut by a close-fitting iron door. In the opposite side of the fire-place is a flue which leads to a chimney; this flue is also low down, almost below the ground. The three sides are covered by a brick arch. The fourth side is provided with iron doors, which open to both sides, and leave the whole fourth side open to any piece of moulding which may be put in. Iron shelves are generally put up along the walls towards the roof, for drying small cores and boxes on. A railroad, which is within the sweep of a crane, leads into the stove, and any heavy mould which is to be

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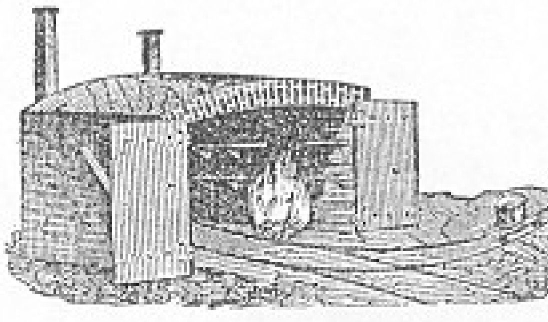
dried may be laid upon a car running on this track, and both car and mould are shoved into the stove, the doors closed, and fire put in the furnace. The size of a drying-stove is varied according to the size of the castings commonly made in a foundry. A stove of twelve feet in all directions, and seven feet high, is a good-sized stove. Foundries which make large castings have to be provided with drying-stoves of the proper size. There are frequently more than one drying-stove in a foundry, often as many as five or six, small and large. If there is no occasion for using a large stove, a small one is selected, because it works faster, and with less fuel. In figure 43 a drying-stove is represented.

Fig. 42.



GENERAL REMARKS.

Cleansing of castings.—When the metal of a cast is so far cooled as to adhere together, and strong enough to bear removal, the moulds are taken apart

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and the sand or loam is removed from the casting. Small castings require but a few minutes to cool, while heavier casts take hours and days. A massive casting, such as a forge-hammer of five tons weight, will take twenty-four hours cooling in a green, and forty-eight hours in a dry mould. A bed-plate for the engine of one of the New York line of Atlantic steamers, weighing thirty-five tons, took a week for cooling and the removal from its mould. Heavy castings are chained to a crane and hoisted by it. Very heavy castings require the united strength of two and more cranes. Small castings are removed from their moulds by tongs; one, two, or more persons taking hold of it at the same time, carry it to a place designed for the reception of such hot castings. The excrescences which may happen to have been formed in the partings or core-joints are broken off as soon as the cast is removed to the general deposit of hot castings. The gates are, at the same time, broken off by the moulder; it requires some degree of skill to break a gate off smoth. Gates and accidental excrescences which cannot be removed in the foundry, are chiselled and chipped off in the yard or in the cleansing-shop. Heavy cores, and particularly hard cores, are removed in the foundry before the casting is entirely cold.

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Time of casting.—The casting in iron foundries is generally performed in the afternoon after three o'clock, so as to make it the last business of the day. This time is chiefly selected to escape the heat of the hot sand after casting, which will then cool during the night. After casting, the castings are removed, and the moulding-boxes piled in a corner of the building, so as to be handy for the next day's work; the sand, after receiving some water, is shovelled over, mixed, and thrown in heaps, where it remains during the night. If the latter work has been properly performed, the sand will be of a proper and uniform dampness the next morning. Each moulder takes charge of his own sand, and but little practice

is required to learn the proper amount of water to be used in damping the sand.

The cleansing of castings is a simple operation in an iron foundry where common castings are made; any workman is fit to trim a coarse casting, or scour it. The first is done by means of chisels or sharp hammers; the latter, with dull, coarse files, which have been used and rejected by machinists. Cast-iron files are also used for the latter purpose. The trimming and cleansing of valuable castings, such as statues or ornaments of art, is not so easily performed. An unskilful workman could undo almost

the whole casting, and all the labour spent upon it, by trimming off a channel or gate. This kind of work is done by an artist skilled in the performance of such labour; and, on valuable statues, it is performed by the original designer of the work, at least so far as particular parts, such as the face, or characteristic elements, are concerned. The trimming of fine castings is an art in itself, which requires more explanation than our limited means allow us to give.

The expenses of moulding and casting are very variable. Moulding of common articles of commerce and machinery in iron, is done by the ton, at prices varying from two to twelve dollars per ton, and even at higher prices. Dry-sand moulding is paid higher than moulding in green-sand, and loam-moulding higher than either of them. The moulding of brass, bronze, or other metals, for monuments of art, is of such variety, and so different are the expenses, that no standard price can be assigned to it. The expenses incurred in melting metal are not very great,—the loss in the metal which is melted is greater than the labour and fuel in melting it. In the cupola, twenty-five per cent. of fuel is consumed in melting iron, including all the fuel used in warming the furnace, the drying stoves, and other incidental uses

of fuel. Besides fuel, there are two labourers at the cupola, one smelter, and one filler. The reverberatory takes from seventy-five to one hundred pounds of fuel to each hundred pounds of iron, including the heating of the furnace. Exclusive of warming, the reverberatory will take but fifty pounds of fuel. One workman can do the work at the reverberatory, but there are generally two. The melting of iron in the crucible is the most expensive: it consumes from fifty to two hundred pounds of coal to one hundred pounds of iron. The greatest expenses are, however, in the crucibles: a good crucible, well-managed, will not last more than twelve heats, and if each heat is fifty pounds, it will melt six hundred pounds of iron. A crucible of this kind will cost fifty cents; but very few crucibles will melt six hundred pounds, and, on an average, not more than three hundred pounds can be calculated upon.

The loss in iron is invariably from five to six per cent. in every case of the different forms of melting; the reverberatory furnace consuming most iron. Each casting always requires more metal than it will finally contain; this surplus iron, consisting of gates, channels, and false seams, increases the above loss; and as small castings make more scrap iron than large ones, it is obvious that the actual loss

will be larger on small casts than on large ones. Machine castings make, on an average, thirty-three per cent. of refuse or scrap in a well-conducted foundry. Commercial articles twenty-five per cent., and large castings less; very small articles frequently make more scrap than ware. The remelting of these scraps costs fuel, and causes a waste of metal, which increases the expense of melting.

Other metals than iron are generally less expensive in melting, being more fusible; and, as far as copper is concerned, there is but little waste if the copper is pure. Bronze will waste a little; the waste in volatile metals, as tin and zinc, can be prevented in some measure, if the surface of the melted metal is covered with a mixture of equal parts of potash and soda, mixed with some charcoal powder. To melt and make bronze in the reverberatory, the copper is melted first, and if there is any bronze on hand, in scraps or other forms, it is added as soon as the copper is melted down; after this, the tin is laid near the liquid copper, upon the hearth, and if any zinc or antimony is to be used, it is added last. Before casting bronze, it is to be well stirred by previously heated iron bars. The amount of potash and soda used to protect the metal, is two pounds to one ton of metal; it is added when all the metals

are melted and a white scum is visible on the surface of

the metal. Bronze metal designed for strong castings, particularly bells, ought to be exposed to the fire in a fluid state for at least eight or ten hours; this will give it a more homogeneous texture and less crystallization. If any zinc is to be added to such an alloy, it is advisable to add it in the form of brass, calculating, of course, the quantity of copper it contains. The relative quantity of the metals forming the alloy can be calculated and mixed according to this arrangement; but the melting operation has an influence upon the strength of the metal. Tin or zinc may be evaporated, and the alloy would not be of the quality intended; the founder, therefore, takes proofs before casting, and if they are not satisfactory, either copper or tin is added to the melted mass. It requires some experience to judge of the quality of an alloy by appearances. Proof is taken by a small iron ladle, the little metal in it is broken after it has cooled, and the form of crystallization and the tenacity of the metal is decisive of the quality of the composition.

Lead, *tin*, and antimony may be melted in a reverberatory furnace; brass, however, is to be melted in crucibles. Brass is sometimes made by melting copper, and adding, after it is melted, as

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much zinc as is needed to form the alloy. A cheaper method is to melt a mixture of copper scraps and zinc ore together with some charcoal powder; or, melt both copper and zinc ore together with carbon. In both cases, however, the brass is to be remelted, because the first smelting does not produce strong and pure brass.

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APPENDIX.

RECEIPTS AND TABLES.

Alloys of Iron.—All admixtures added to iron make it more fusible than it originally is; these may be metals or metalloids.

Sulphur causes iron to be more fusible if melted together, but this mixture is more liable to corrosion than pure iron. A little sulphur does not injure cast iron, but more than one per cent. makes it brittle when cold. If there is any sulphur in iron when hot, it causes the iron to be brittle.

Carbon is contained in all cast iron from two to six per cent.; it makes the iron fusible; if the amount contained is too large, it renders it brittle. A little carbon makes cast iron brittle and hard. Hard cast iron assumes as beautiful a polish as hardened steel.

Phosphorus makes iron brittle when cold. It imparts a brilliancy and white colour to iron more perfectly than any other matter. Phosphorus makes iron very hard, but renders it liable to corrosion; one-half or one per cent. causes a great alteration in the quality of iron.

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Silicon is a constant companion of cast iron; hot-blast iron contains more of it than cold-blast; it also contains more sulphur and phosphorus if any is present in the ore or coal. Silicon makes iron brittle and hard, and has a similar effect on it as phosphorus.

Arsenic imparts a fine white colour to iron, but makes it brittle.

Chromium causes iron to be as hard as diamond, but it is difficult to make this combination.

Gold combines very readily with iron; it serves as a solder for small iron castings, as breast-pins and similar articles.

Silver does not unite well with iron, but a little may be alloyed with it; it causes iron to be very hard and brittle. The alloy is very liable to corrosion.

Copper, if alloyed with iron, causes it to be brittle when hot, but increases its strength considerably when cold, if the amount of copper is not more than one-fourth of 1 per cent.; more copper than this causes cold-short.

Tin, with iron, makes a hard, but beautiful alloy, which, if nearly half-and-half, assumes a fine white colour, with the hardness and lustre of steel.

Lead combines with iron, but, like silver, in a small proportion; it causes iron to be soft and tough.

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Alloys of iron are very little in use at present, but we call attention to such alloys, because the easy method by which, at present, iron is gilded, silvered, or coated with other metals, and also the covering of iron with glass, enamel, and varnish, may, and undoubtedly will lead to the use of iron alloys with greater advantage than the common cast iron is used.

Alloys of Precious Metals.—There are but few which claim our attention. The gold coin of the United States is composed of 90 parts of gold, 2.5

silver, and 7.5 copper; 75 parts of gold, 25 of copper, and often a little silver, is the composition for most trinkets; 66.6 gold, 16.7 silver, and 16.7 copper, forms the solder for gold and iron. Fine silver plate and medals are generally composed of 95 parts silver and 5 copper. Silver solder is 66.6 silver, 30.4 copper, and 3.4 brass.

Alloys of Copper are the most numerous and useful. *Bronze*, or bell-metal, is one of the most beautiful of these alloys.

72 parts copper, $26\frac{1}{2}$ parts tin, and $1\frac{1}{2}$ parts of iron is said to be a superior bell-metal. Iron, tin, and copper do not unite well if each is added separately to the other, but if tin-plate scraps are melted in a crucible together with tin, and then this tin

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and iron alloy added to the melted copper, it will unite readily.

Common Bell-metal consists of 100 parts copper and 30 or 40 tin; it is more brittle and of not so good a tone as the other. Another receipt prescribes 78 parts of copper and 22 of tin as a first rate bell-metal. Another highly recommended composition is 80 copper, 10.1 tin, 5.6 zinc, and 4.3 lead. The latter composition is of a good sonorous sound, even if the mould has not been quite dry. The silver bell of Rouen, France, consists of 80 copper, 10 tin, 6 zinc, 4 lead. Too much tin causes the composition to be very brittle. Some bell-founders recommend the addition of a small portion of silver to the composition, but it appears there is no particular necessity for it.

Bronze of great tenacity is composed of 9, 10, or 11 parts of copper to 1 of tin. If this alloy is cast in large masses, it has the peculiarity of separating into parts which contain more or less tin or copper. The tin is generally found on the higher parts of the cast, the copper predominating in the lower parts. This composition, besides being strong, is very hard, and resists abrasion very effectually; it also is very little acted upon by the atmosphere. The ancients used to make their weapons

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and edged tools of a similar composition,—to which, however, a little phosphorus appears to have been added,—before the invention of steel. If bronze is suddenly cooled, by heating and plunging it in cold water, it becomes less dense and hard, and increases its malleability; but this is not the case in the same degree with all compositions, but the tone of the metal is decidedly impaired, and bells ought never to be cast in damp moulds. Bronze made of the last composition is improved by being tempered, while the tenacity of bell-metal, by the same process, is reduced to one-third of its original strength. The alloy of 80 copper and 20 tin bears tempering best, and increases in strength. The gongs or cymbals, and tamtams of the Chinese, are composed of 80 copper and 20 tin. To give these musical instruments their sonorous property, they are plunged in cold water after being cast; a reheating to ignition, however, is to precede the refrigeration. After this latter process, which deprives the metal of almost all its sound, it is tempered, and very slowly cooled, which imparts to it the capacity of emitting that peculiarly powerful sound.

Bronze for Statues is of a great variety of composition. We also find alloys for this purpose composed like bell-metal, and also of almost pure copper.

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Modern statues are composed of a composition of 80 copper and 20 tin. The present state of the art of making valuable bronze castings is, however, so imperfect, that our age cannot be considered competent to give a standard of metal compositions for that purpose. The French artists, in the first part of this century, were so ignorant in this peculiar art, that some parts of the Vendome column are an alloy of 94 copper and 6 tin, while other parts contained but $\frac{1}{5}$ of alloy to $99\frac{4}{5}$ of copper. These defects caused bad castings, so that the chisellers had to cut off seventy tons of protuberances on this one monument. At the time of Louis XIV., a period when the art of casting statues was more cultivated in France, statues were cast of an alloy consisting of 91.3 copper, 1 to 2 tin, 5 to 6 zinc, and 1 to 1.5 lead. The statue of Louis XV. is cast of copper 82.4, zinc 10.3, tin 4, and lead 3.2.

The Bronze of the *Ancient Greeks* consisted chiefly of copper and tin, but was frequently alloyed with gold, silver, lead, zinc, and arsenic. The Greeks not only made statues, tripods, lamps, and other articles of art of bronze, but also their weapons, shields, coin, nails, kitchen utensils, and chirurgical instruments. The ancients understood the art of

hardening and tempering bronze to perfection, so
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that the want of steel was not so severely felt as we may be inclined to believe at the present time.

The Ancient Mexicans—Aztecs—understood the art of converting bronze into edged instruments in a high degree. To small castings, an addition of iron, in the form of tin-plate scraps, appears to be advantageous: large articles are liable to crystallize by the addition of that metal.

Speculum Metal is generally composed of $66\frac{1}{3}$ copper and $33\frac{2}{3}$ tin, it is white, and has a brilliant lustre, and is susceptible of a high polish. An ancient mirror was found to consist of 62 copper, 32 tin, and 6 lead. In France, 2 parts of copper and 1 part of tin are used, which are melted separately in crucibles, and mixed just before casting. The addition of a little arsenic, one or two per cent., makes the metal more compact, and gives it a greater lustre and hardness, but renders it liable to be tarnished by the air. *The speculum metal* of Lord Rosse's large telescope is composed of 126.4 copper and 58.9 tin. This alloy is of a brilliant white lustre, and has a specific gravity of 8.811; it is nearly as hard as steel, and as brittle as sealing-wax. The speculum is cast 6 feet in diameter and $5\frac{1}{4}$ inches thick, and weighs upwards of three tons. The casting of this mirror was an interesting process. After repeated
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failures and experiments, a mould was made whose bottom consisted of a wrought-iron ring, packed full of hoop-iron laid edgeways, so close that air, but no metal, could escape through the crevices. This bottom was turned convex on a turning-lathe, true to the concavity of the speculum; it was then placed upon a level floor and enclosed by a sand-dam, left open from above. The metal was melted in cast-iron crucibles, because wrought iron or clay would have injured the alloy. The cast was carried while red hot into the annealing oven, which was previously heated to a red heat, and left there sixteen weeks to cool.

Bronze for Medals generally contains least tin. 100 copper with 4.17 tin has been proposed, but this alloy is so hard, that it has been found necessary to cast the coin. Bronze medals are, however, stamped when composed of 92 copper and 8 tin, a little zinc being added in a form of brass.

Bronze in imitation of Gold, consists of 90.5 copper, 6.5 tin, and 3 zinc.

If bronze is to be gilt, it should be of easy fusion, and take perfect impressions of the mould. A combination of copper, tin, zinc, and lead, as previously noticed for statues, is the best in this case. An alloy which is said to possess the best properties for
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being gilt, was composed of 82.25 copper, 17.48 zinc, .23 tin, .02 lead. An alloy for gilding is to be compact and of close grain. It absorbs gold and mercury in proportion to its porosity.

Brass is a composition of copper and zinc; 2 parts of copper and 1 of zinc—or more correctly $63\frac{1}{2}$ copper and 32.3 zinc—form common brass. Two parts of brass and one of zinc form hard solder; to this a little tin may be added. If the solder is to be tough, as for pipes or kettles, which are to be drawn or beaten, but $\frac{2}{3}$ of zinc are to be added to 2 of brass. *Button-brass* consists of 8 parts of brass and 5 of zinc. *Red-brass* or tombak is made of 8 or 10 copper, and 1 zinc, or, as in some German works, of 11 copper and 2 zinc. *Princes metal*, Similor, Nurnberg gold, or Manheim gold, are different compositions, varying between 3 copper and 1 zinc, and 2 copper and 1 zinc. These elements are separately melted, and mixed together by constant stirring. Brass containing a little lead, from one to two per cent., is more easily turned than common brass, but is more brittle. Brass which is best adapted for hammering consists of 70 copper and 30 zinc. Tempering and sudden refrigeration has a similar effect on brass as upon bronze; the first renders it hard and more tenacious, and the latter
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soft. A little zinc makes a reddish brass, and imparts a golden hue; larger quantities make it a greenish yellow, and more than fifty per cent. of zinc causes brass to be of a bluish gray colour. *Brass for ship nails* consists of 10 copper, 8 zinc, and 1 iron. Brass for pans and steps to run machine shafts in, is to contain less zinc than common brass; an addition of bronze to brass increases its applicability for such purposes. It is said that 16 copper, 1 zinc, and 7 platinum is almost equal to gold. If melted red-brass is stirred with an iron or steel rod, so as to impart a little iron to it, its strength is sensibly augmented. The variety of brass composi-

tions is so numerous, as to make it impossible to note all the known compounds. In the above, the most useful alloys are enumerated.

German-silver, Argentan, or Chinese Packfong, is one of the most valuable alloys; it nearly combines the durability of silver and the utility of iron, steel, and copper. Common German-silver is composed of 60 copper, 25 zinc, and 15 nickel. A better quality is 50 copper, 25 zinc, and 25 nickel. *Chinese packfong* consists of 55 copper, 17 zinc, 23 nickel, and 3 iron. A highly sonorous, tenacious *Argentan*, which can be hammered and rolled, resembling silver more than any other compound, is composed of

40.4 copper, 25.4 zinc, 31.5 nickel, 2.6 iron. At present, a fine argentan, and one the best qualified to be plated with silver by the galvanic process, is made of 62 copper, 19 zinc, 13 nickel, and 4 to 5 cobalt and iron. This argentan is very close, strong, and cheap, and may be covered by one or two per cent. of silver, forming a good fine plate. A very tenacious, ductile, and hard argentan may be made of 57.4 copper, 25 zinc, 13 nickel, and 9 iron. This alloy can be substituted for steel in many of the common uses of steel, particularly where corroding influences upon steel are strong, because this alloy is not affected by atmospheric air. *Electron*, a fine quality of argentan, is composed of 8 copper, 4 nickel, and 3.5 zinc. *Solder for German silver* is made by adding 4 parts of zinc to this composition, then laminate and pound it to a coarse powder.

Before we part with copper alloys it will be proper to allude to some combinations of copper with other matters which are useful to know. *Copper and platinum* form a yellow alloy hardly distinguishable from gold. *Copper and silver* do not form any distinguished amalgam; the addition of a little arsenic to such an alloy makes it whiter and more like silver. A little copper and antimony make a fine rose-coloured alloy; if the copper is increased, it assumes

a darker hue; equal quantities make a violet compound, and more copper increases the dark shade. This alloy is brittle in all proportions; 90 parts of copper, 5 antimony, and 5 zinc, are used for plumber-blocks, and pans and steps for steel and iron gudgeons to run in. *Carbon* makes copper very brittle. *Phosphorus* makes copper as hard as steel, so that it can be used for knives and edge-tools; it, however, renders copper more liable to corrosion. The appearance of this compound when newly polished is like pure copper, but it is very soon covered or tarnished with a greenish-black covering. This greenish black being the colour of ancient weapons, renders it probable that the ancients hardened their copper or bronze tools by means of phosphorus. *Copper and arsenic* form a bright white alloy, which is used for candlesticks, buttons, dials, and similar articles, but as this compound is easily soluble and highly poisonous, it cannot be used where food is brought in contact with it. This alloy is made by melting copper scraps and white arsenic—arsenious acid—in a crucible, covering it with a layer of common salt. It has almost the colour and density of pure silver, but is very liable to corrosion.

Lead and its alloys are very extensively used; the alloys are usually harder and less tough than lead. *A*

small amount of arsenic is added to the lead to make shot; arsenic is more fusible and more brittle than lead; for fine shot, three pounds of arsenic, and for coarse eight pounds, to one thousand pounds of lead, are generally used. To alloy lead with arsenic, nothing more is needed than to melt white arsenic together with metallic lead; half the weight of the arsenic employed will be absorbed by the lead. 5 *lead and* 1 *antimony*, to which frequently a little zinc and bismuth are added, forms type metal. A good French type metal is said to consist of 2 lead, 1 antimony, and 1 copper. Common type metal is 80 lead and 20 antimony; a more fusible stereotype metal is 77 lead, 15 antimony, and 8 bismuth. Some stereotype founders add tin to the above, that is, add to lead, antimony, and bismuth, tin; or leave the bismuth out and supply its place by tin. If much tin is used it renders the metal rather soft, but fusible and fit for fine impressions. A superior alloy is said to consist of 9 lead, 2 antimony, and 1 bismuth. To alloy lead with these metals, the lead is first melted, and the other metals added to the fluid lead. *Fusible metal* may be compounded of various degrees of fusibility; 31 lead, 19 tin, and 50 bismuth may be fused at 203°. An alloy which fuses at 149°, and which is used for plugging teeth, consists of 28.5

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lead, 45.5 bismuth, 17 tin, and 9 mercury. 8 of bismuth, 5 of lead, and 3 of tin, will melt at the boiling heat of water, or 212°. Bismuth makes lead stronger if the amount of bismuth does not exceed that of the lead; two parts of bismuth and three parts of lead is said to be ten times stronger than lead, and as the durability of bismuth is equal to lead, it forms a good alloy for making pipes and wire.

Tin forms a range of very useful alloys. *Tin and lead* melt together in all proportions. Most of the tin vessels which are called pure tin are alloyed with lead. Soft solder is 33 tin to 67 lead, and in all proportions from that to 67 tin to 33 lead; half-and-half is common soft solder. *Plate pewter* is composed of 89 tin, 2 bismuth, 7 antimony, and 2 copper. *Queen's metal,* of 75 tin, 9 lead, 8 bismuth, 8 antimony. *Britannia metal,* of 89 tin, 2 copper, 6 antimony, 2 brass, and 1 iron. *Common pewter,* or German tin, is composed of 4 tin and 1 lead. The best plate pewter is 100 tin, 8 antimony, 2 bismuth, and 2 copper. *Music metal* is 80 tin and 20 antimony. *Spurious silver leaf* is 50 tin and 50 zinc. Antifriction metal is a variable compound of lead, antimony, tin, and copper. *Organ pipes* are made of a composition of 9 tin and 1 lead; these proportions

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are varied by different artists. 29 tin and 19 lead form a fusible compound, of which imitations of diamonds and precious brilliants are made. To make such imitations, a glass rod is ground at one end in the form which is to be represented, whether a brilliant or rose-diamond. The melted metal is skimmed by a paper card, and the ground facetted end of the glass rod dipped in the clear metal; on withdrawing the rod a thin film of metal will adhere to the cold rod, which, when taken off, will show a hollow capsule having the lustre of a diamond. We find such diamonds at present used to make sign-boards in show windows. This metal forms excellent reflectors, which may easily be made by dipping a round bottle or the bottom of a retort in the metal; but the metal is tarnished by anything coming in contact with it. 1 part tin, 1 lead, 2 bismuth, and 10 mercury is very fusible; with this compound glass pipes and glass globes are coated with a thin film, by placing some of this metal in the article to be coated, and allowing it to flow round, thus giving it the brilliancy of silver. *Tin foil,* if designed for mirrors, is pure tin, but common tin-foil is lead and tin—often tin, zinc, and lead; it has so great a variety of composition, that no standard can be assigned it. Tin-foil is made either by hammering

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or rolling, but most of it is made by casting the hot metal over an inclined plane, made of a frame covered with cotton or linen canvas. It requires some skill to perform the latter operation.

Zinc, alloyed with other metals, has already been enumerated. In its pure state it forms fine sharp castings, good for ornamental purposes; but as these castings have no strength, they are not much used for other purposes. A composition of lead and zinc is used for patterns, but with little advantage; it is soft and flexible, and the patterns soon lose their shape.

BRONZING.

When bronze metal has been exposed to the atmospheric air for a long time, it assumes a dark green colour. This colour, a rich hue, may be imitated by chemical agencies, or by paint. Bronze metal, after being cleaned, is bronzed by being painted or immersed in a solution of two parts of verdigris and one part of sal-ammonia, dissolved in vinegar, boiled and filtered, and used very dilute. It is left in this solution or brushed over until the desired hue is obtained. *The colour of antique bronze* is obtained by painting the bronze cast with a solution of one part of sal-ammonia, three parts cream of tartar, six parts of common salt, the whole dissolved in twelve parts of hot

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water; with this are to be mixed eight parts of a solution of nitrate of copper. This solution should be laid on in a damp place. The first mixture will give a more reddish dark green colour to bronze than the latter. Different tints may be imparted to bronze and brass, from red to bright yellow, and from dark to light green. *Boiling bronze* in muriatic acid will give it a red colour; and soaking it in ammonia renders it whiter than it already is. Bronze painted with a thin solution of equal parts of sal-ammonia and oxalate of potash, in a warm room, or in the heat of the sun, gives it a fine green colour, particularly if rubbed with it. If a dark blackish bronze

colour is required, the foregoing solution is laid on in a room where some liver of sulphur—sulphuret of potassium—is dissolved in water, and set out in flat dishes to generate sulphuretted hydrogen, which will cause a uniform blackish brown colour on bronze or brass. The foregoing receipts answer for brass as well as bronze. When the desired colour is obtained, the object is washed in clean water, dried, and then rubbed with a brush and wax. The bronze for the latter operation is heated, but not so much so as to burn the wax.

Bronze colour is imparted to other castings besides brass and bronze, by paint. Cast iron may be bronzed

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by dipping it in a thin solution of sulphate of copper, or muriate of copper, and when sufficiently covered with copper, it is washed and painted with oil varnish. All objects to be bronzed may, however, be painted of any colour, either a shade of green, from the faintest to an almost black green, or of a blue or bluish green. The paint cover should be coated with pure varnish, and when that is nearly dry, a metallic powder is dusted over it by a dusting-bag, or rubbed on by the fingers, a linen pad, or a paint-brush. The metallic powder is generally mosaic gold, which is made of almost every shade, and is of great beauty; or it may be copper in powder, gold leaf, silver leaf, and similar articles; dry paint of a convenient shade may also be used. The highest parts of the articles are generally bronzed so as to appear as if rubbed and worn by use. Over the whole of these, a last coating of spirit varnish is laid on.

The gilding of bronze and brass castings is performed, in the dry way, by making the surface perfectly smooth, then brushing it over with an amalgam of gold, and dissipating the mercury by heat, which leaves a durable film of gold over the surface. This surface may be burnished or deadened. The amalgam is made by heating one part of gold, in

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thin laminæ, in a crucible, and when it becomes faintly red, pour over it eight parts of mercury, pour the combined gold and mercury into cold water, and squeeze the surplus mercury out. The amalgam is then enclosed in canvas or chamois leather, and some more mercury pressed out; the remainder will contain one part of gold to two parts of mercury. This amalgam is rubbed over the objects to be gilded: it may be had in its true composition from the gold mines of Virginia, and of the best quality from North Carolina. It is advisable to brush the brass over with a thin solution of nitrate of mercury and some free nitric acid, as this facilitates the adherence of the amalgam. The gilt and burnished articles may be coloured by a simple process to any shade from a bright and crimson red to a violet and deep blue, by being submerged in a bath of caustic potash in which some metallic oxide is dissolved, but, as a galvanic process is to be applied here, it is beyond our province to describe it. There are other methods of gilding which, for the same reason, must be excluded.

Iron may be gilded by brushing it over with a solution of gold in sulphuric ether. The iron is to be bright and polished, and the gold rubbed on by the burnisher. This is not very durable gilding.

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Tinning of brass, bronze, and copper, is done by washing the surface of the cast with very diluted sulphuric acid, after which, wash in water, and scour with sand. The object is then heated to the melting point of tin, and the tin, having been previously melted, is rubbed over the surface by means of a damp rag or piece of oakum, first covered with rosin, to protect the tin against oxydation. Cast iron must be turned or filed, so as to offer a clean surface, before it can be tinned. A solution of tin, as muriate of tin, mixed with an equal part of sal-ammonia, if brushed over the metal, will highly facilitate the operation of tinning. A more convenient mode of tinning than the above, is to plunge the object to be tinned in a solution of tin and caustic potash, which solution is to be as hot as it can possibly be made. Such a solution of tin is made by dissolving oxyde of tin—putty of tin—in potash ley, adding to the saturated solution some metallic tin, in the form of filings or shavings of tin. A few minutes are sufficient to cover brass or copper with tin.

Zinking of copper or bronze may be done by exposing the objects to the fumes of zinc. On copper castings, it is often desirable to have some parts of a golden or yellow hue, which may be done by

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exposing those parts to the fumes of zinc. A very perfect coating of zinc may be obtained by placing the objects, well cleaned, in a solution of chloride of zinc, in which a surplus of metallic zinc is present. Chloride of zinc is made by dissolving zinc in muriatic acid, always having so much zinc in the acid, that some of it will remain undissolved. Zinc dissolved in sal-ammonia is as efficacious as the foregoing.

Glazing of metal castings, or coating with enamel, is very little practised, and will hardly ever amount to a lucrative operation. Iron to be coated with an enamel is first well cleansed by means of acid and scouring with sand. It is then uniformly covered with the enamel, which has been previously prepared or melted, finely ground, and mixed with water for the purpose of laying it on. This operation is very little practised, as it is very expensive and the product is not durable. It has been, and still is used for covering the interior of cooking utensils to prevent their cooking black. A better means to accomplish this object in a cheaper way, is the application of cast iron, which contains a little phosphorus, and not too much carbon, as has been previously remarked. More recently, a new invention, that of covering iron with transparent glass, and also with coloured

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glass, has made its appearance in England. Serious doubts, however, may be entertained as to its ultimate success. Iron coated with enamel or glass can never be brought to a successful competition with porcelain either in beauty or price.

Blackening of iron casts is either done with black-lead, moistened with alcohol, or, in many instances, with spirits of turpentine. This is laid on by a brush, and rubbed until the blackening is dry, and assumes a metallic lustre. This is the blackening used for stoves. If the object to be blackened is a little warm, the operation works better and much more quickly.

Fine ornamental castings are heated to the blue annealing heat, and then covered with black copal varnish, and dried at the same degree of heat. The heat takes most of the gloss of the varnish off. The copal varnish is then blackened by an admixture of finely rubbed lamp-black, or printers' ink, or, still better, by finely ground pure bone-black. Larger castings are blackened with common black paint. A rich lead-colour may be imparted to castings by an oil paint, made of fine litharge gently heated in an iron pan, and, when hot, some flour of sulphur finely and uniformly sprinkled over it under constant stirring. The resulting sulphuret of lead assumes a

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rich lead-colour, which is not altered by oil or the atmosphere.

Grinding of cast iron is resorted to where any smooth, polished surface is required. It is done on large, fast-revolving sand or grind stones. Cast iron is generally hard on its surface and sandy, so that it would require too much labour to file it, besides wearing out too many files. Machine castings are planed or turned by proper machinery.

Malleable cast iron, an article now very much in use for carriage and harness furniture, and various other purposes, is made of the best kind of No. 2 charcoal pig. Where the foundry scraps are of a good quality of iron, they are preferable. A good article may be made by mixing No. 2 and No. 3 iron. Any pig iron which makes good bar iron will make malleable iron. Most of the malleable iron is cast from the cupola, but the crucible makes better castings of the same material. The cast articles are tempered in an iron cylinder, and imbedded in fine fresh river sand, or finely pounded iron ore, or black manganese, or a mixture of the whole of these materials. An exposure of the hardest cast iron, if pure, from twenty-four to thirty-six hours to the fire, will render it malleable to a certain degree. When tempered, the articles are put in a revolving iron barrel

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together with some sand, to be cleaned and polished, to a certain extent, by rubbing one against the other. This malleable iron is particularly qualified for being tinned, or plated with brass or silver. For the silvering of iron, a process has been lately recommended which appears to be valuable: it is performed by means of galvanism. The iron article, well cleaned and freed of all oil and grease, is immersed in a solution of silver, and connected with the zinc pole of a galvanic battery; the copper pole is connected with a platinum plate placed in the solution at some distance from the cast iron. The silver solution consists of cyanide of silver. It is made by putting cyanide of potassium in a well-

corked vessel, together with freshly prepared chloride of silver; the whole is then covered with water and violently shaken. It is advisable to use an excess of chloride of silver, and if a little remains undissolved, add a few pieces of cyanide of potassium. A little chloride of silver ought to remain after all the cyanide is saturated. This solution is filtered, to render it perfectly clear, and is then ready for use. It is said that a few minutes' time is sufficient to cover a large surface of iron with silver.

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TABLE I.

Weight of a lineal foot of cast-iron pipes in pounds.

Diameter of bore in inches.	Thickness of metal in inches.							
	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{8}$	$1\frac{1}{4}$
2	8.8	12.3	16.1	20.3				
$2\frac{1}{2}$	10.6	14.7	19.2	23.9				
3	12.4	17.2	22.2	27.6	33.3	39.3	45.6	
		19.6	25.3	31.3	37.6	44.2	51.1	
$3\frac{1}{2}$	14.2	22.1	28.4	35.0	41.9	49.1	56.6	64.4
4	16.1	24.5	31.4	38.7	46.2	54.0	62.1	70.6
$4\frac{1}{2}$	18.0	27.0	34.5	42.3	50.5	58.9	67.6	76.7
5	19.8	29.5	37.6	46.0	54.8	63.8	73.2	82.8
$5\frac{1}{2}$	21.6	31.9	40.7	49.7	59.1	68.7	78.7	88.8
6	23.5	34.4	43.7	53.4	63.4	73.4	84.2	95.1
$6\frac{1}{2}$	25.3	36.8	46.8	56.8	67.7	78.5	89.7	101.2
7	27.3							
$7\frac{1}{2}$	29.0	39.1	49.9	60.7	72.0	83.5	95.3	107.4
8	30.8	41.7	52.9	64.4	76.2	88.4	100.8	113.5
$8\frac{1}{2}$	32.9	44.4	56.2	68.3	80.8	93.5	106.5	119.9
9	34.5	46.6	59.1	71.8	84.8	98.2	111.8	125.8
$9\frac{1}{2}$	36.3	49.1	62.1	75.5	89.1	103.1	117.4	131.9
10	38.2	51.5	65.2	79.2	93.4	108.0	122.8	138.1
$10\frac{1}{2}$		54.0	68.2	82.8	97.7	112.9	128.4	144.2
11		56.4	71.3	86.5	102.0	117.8	133.9	150.3
$11\frac{1}{2}$		58.9	74.3	90.1	106.3	122.7	139.4	156.4
12		61.3	77.4	93.6	110.6	127.6	145.0	162.6
13			82.7	101.2	118.2	137.4	154.1	173.5
14			89.3	108.2	126.5	146.2	165.3	185.2
15			95.2	115.7	135.3	156.2	176.2	198.1
16				123.3	143.1	166.1	187.5	211.3
17				130.2	152.5	178.5	198.2	223.4
18				137.0	161.2	185.3	209.1	235.6
19					169.2	195.7	222.3	247.1
20					178.1	205.2	233.2	259.0

N. B. The two flanges of a pipe are considered equal to the weight of one foot in length.

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TABLE II.

Dimensions of cylindrical columns of cast iron to sustain a given load with safety.

Diameter in inches.	Height in feet.											
	4	6	8	10	12	14	16	18	20	22	24	
2	72	60	49	40	32	26	22	18	15	13	11	Weight in cwt.
3	178	163	145	128	111	97	84	73	64	56	49	
4	326	310	283	266	242	220	198	178	160	144	130	
5	522	501	479	452	427	394	365	337	310	285	262	
6	607	592	573	550	525	497	469	440	413	386	360	
8	1333	1315	1289	1259	1224	1185	1142	1097	1052	1005	959	

N. B. If the columns are hollow, the area to the given diameter is to be converted into the ring, or the difference of the outer and inner diameters multiplied by $\frac{3}{2}$, because hollow cast-iron columns are stronger than solid ones in that proportion.

TABLE III.

Showing the tenacities, and resistances to compression, of various simple metals and alloys.

METALS AND ALLOYS.	Tenacity, A bar of one inch square section, will be torn asunder by	Resistance to Compression. One square inch will be crushed by	Resistance to Torsion.
	Pounds	Pounds	
Cast Iron	15,000 to 30,000	86,000 to 100,000	9.0
Copper, Wrought	33,000		4.3
Malleable Iron	56,000 to 70,000		10.0
Lead	1824		1.0
Steel	120,000 to 150,000	200,000 to 250,000	16 to 19
Tin	5000		1.4
Zinc	9000		
Common Brass	17,900	10,300	4.6
Swedish Copper 6 parts, Malacca Tin 1 part	64,000		5.0
Chili Copper 6 parts, Malacca Tin 1 part	60,000		
Common Block Tin 4 parts, Lead 1 part, Zinc 1 part	13,000		
Common Block Tin 3 parts, Lead 1 part	10,200		
Common Block Tin 3 parts, Zinc 1 part	10,000		
Lead 1 part, Zinc 1 part	4500		

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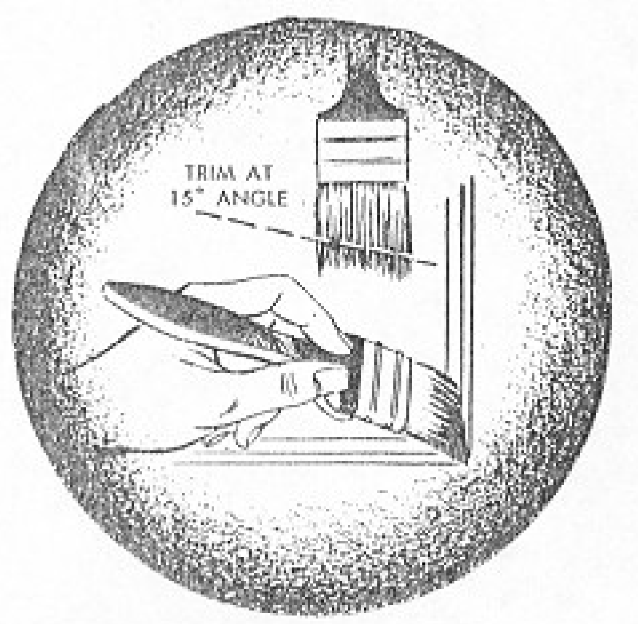
TABLE IV.

Specific gravities of metals and alloys. Water 1000.

METALS AND ALLOYS.	Specific Gravity.	The weight of a cubic inch is in pounds	Number of cubic inches in one pound.	The weight of a cubic foot is in pounds	Melting point in degrees.
Platinum	19.500			1208	
Gold	19.258		1.435	1203	2016°
Mercury	13.500		2.038	843	
Lead	11.352	.4103	2.435	708	612°
Silver	10.474		2.638	652	1873°
Bismuth	9.823		2.814	613	476°
Copper, Cast	8.788	.3185	3.146	550	1996°
" Wrought	8.910	.3225	3.103	555	
Iron, Cast	7.264	.2630	3.806	450	2786°
Steel	7.816		3.530	489	
Tin, Cast	7.291	.2636	3.790	456	442°
Zinc, Cast	7.190	.2600	3.845	449	773°
Gold 90, Silver 2.5, Copper 7.5	17.40				
Gold 66.6, Silver, 16.7, Copper 16.7 (Solder for Gold.)	12.40				
Zinc 10.0, Silver, 66.6, Copper 23.4 (Solder for Silver.)	9.84				
Bronze	8.48 to 8.91			537	
German Silver	8.48 to 8.57				
Brass	8.4 to 8.5		3.533	537	1900°
Type Metal	9.854			616	
Soft Solder	9.55				
Music Metal	7.1				
Water	1.000			62.5	

Popular Mechanics
Dec., 1952

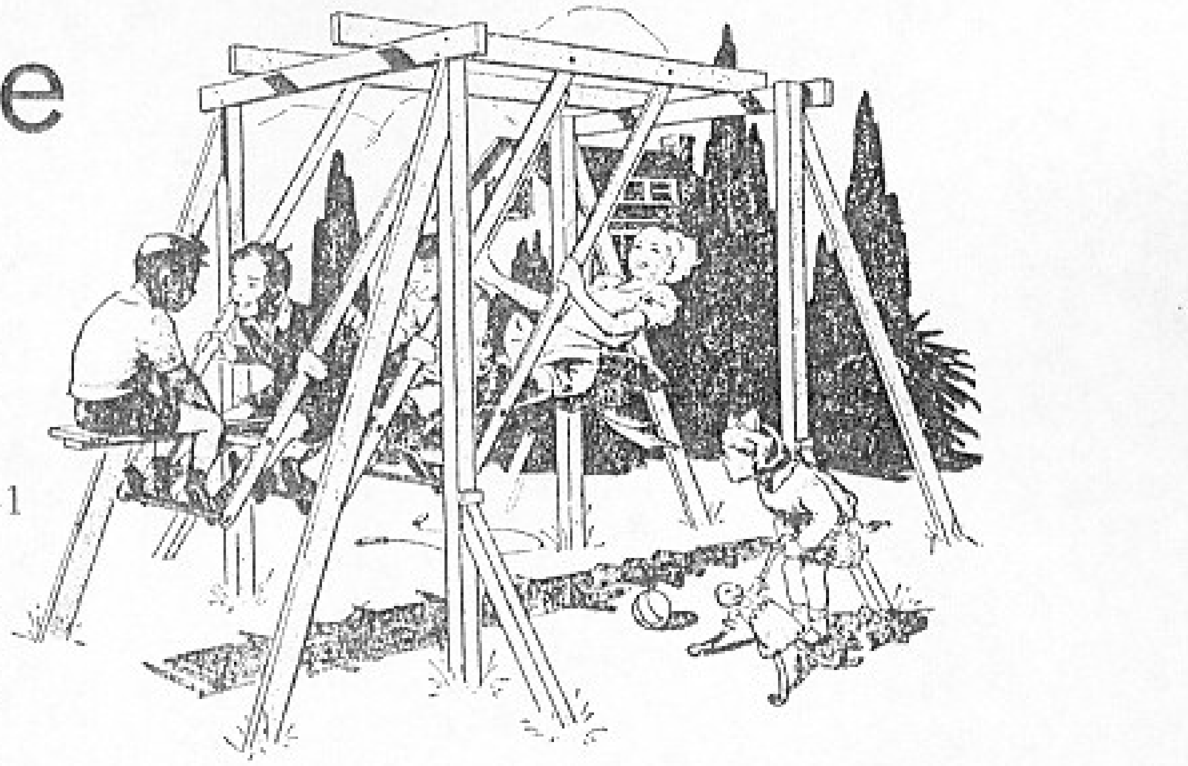


TRIMMING ENDS OF WORN BRISTLES at a 15-deg. angle transforms old paintbrush into an excellent sash brush. By tapering bristles to a chisel edge, cutting-in corners of window sash is no problem

Four-Place Swing

DESIGNED FOR SAFETY

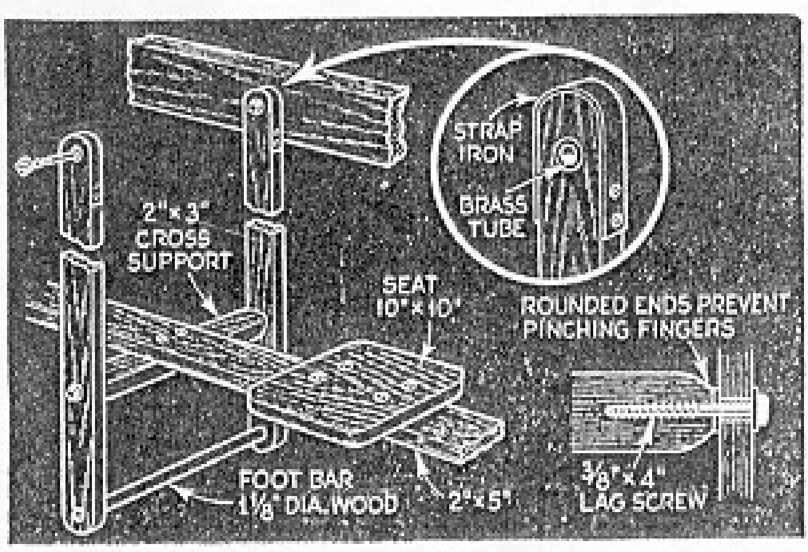
Giant Home Workshop Manual, 1941

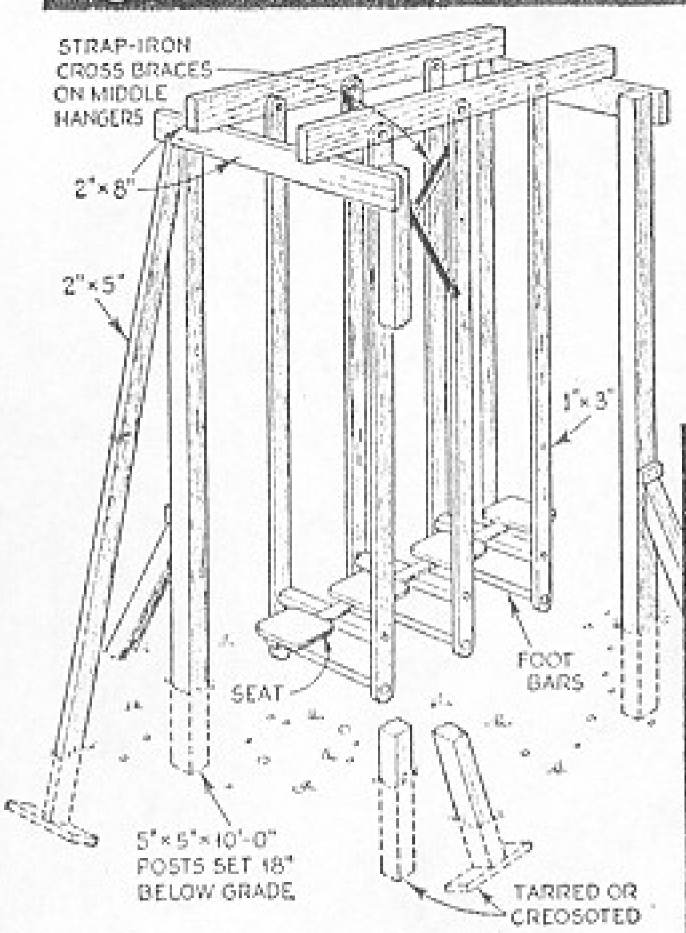


ALTHOUGH the unique swing shown in the accompanying illustrations can accommodate four children as passengers, one child can swing it alone without undue effort. It is so designed that side sway is eliminated, and there is no place where wandering fingers are likely to be pinched—always an important consideration where children are concerned. Passengers in the swing may sit facing either way.

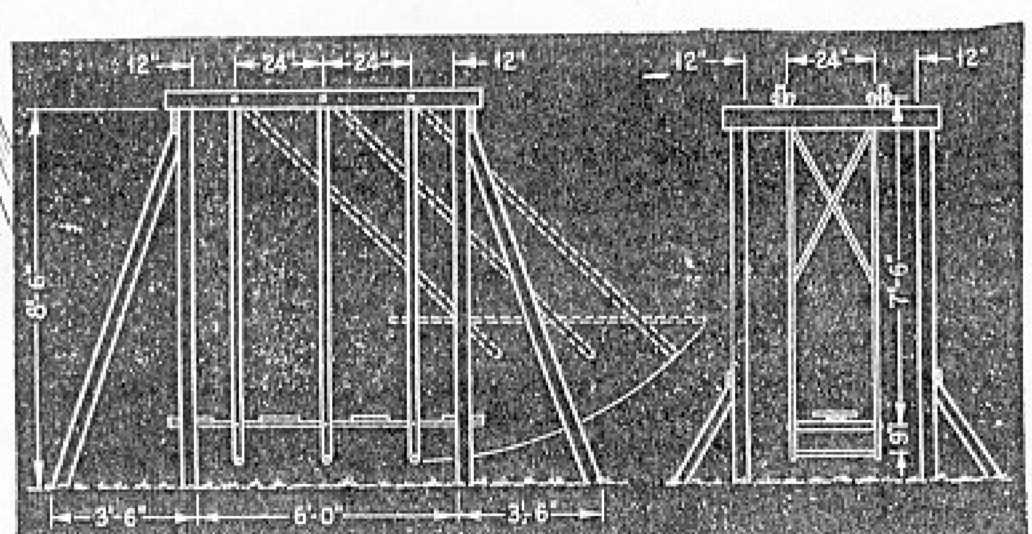
Make the framework of sound material approximately the sizes specified. The bottoms of the posts which go into the ground should be treated with asphaltum paint or creosote to forestall decay. For the hangers that support the swing, select vertical grain pine or other strong, straight-grained, knot-free material. The ends are reënforced with strap iron to prevent splitting, and short sections of brass tube are set in the bolt holes to provide durable and noiseless bearings. One of the reasons most outdoor equipment loses its popularity is, indeed, the noise and looseness of neglected bearings. However, even if oiling is neglected, the brass bearings of this swing will give little annoyance.

The cross members supporting the seat plank are rounded at the ends so that there will be no crevices to catch clothes or pinch fingers. Another advantage of the design is that it provides ample leg room. Strap-iron cross braces are fastened on the middle hangers as shown in the end view below to prevent side sway.





The general method of assembly appears in the small side and end views below. The broken-away perspective view at the left and the larger sketches above show the actual details



VICTORY BARNYARD

HOW TO PRODUCE YOUR OWN MEAT, EGGS, MILK, AND POULTRY

PAUL W. CHAPMAN
DEAN, COLLEGE OF AGRICULTURE
UNIVERSITY OF GEORGIA

1943

RABBITS WILL SUPPLY YOUR MEAT

Rabbits always play an important part in the food economy of wartime. During the First World War, when the people of Australia were not so busy as at the present time, large numbers of Aussies went rabbit hunting. Their bag of game, which was enormous, was dressed, frozen, and shipped to England to supply food for the Britishers at home.

Again the people of England are eating rabbit. They are not only eliminating wild rabbits as a pest, but raising domestic rabbits in hutches, which may be seen around many homes. Clubs not only foster rabbit production but supply useful information regarding management to those who are beginners in this home meat-production project.

Americans eat rabbits, too. Ordinarily domestic rabbit meat sells at a very satisfactory price to those engaged in the business of supplying it; but following the First World War, in the United States the meat became very cheap because thousands and thousands of city people, while prices were high and meat scarce, went into the business of raising rabbits in the back yard.

Again Americans are going into the rabbit business. Breeders report a very large increase in sales to city dwellers who, in the present emergency period, expect to grow a part of their meat supply at home.

California leads in rabbit production, but some of the states in the East are not far behind. The Federal government maintains a Rabbit Experiment Station at Fontana, Calif. Workers at this station a few years ago made a survey of consumption in the Los Angeles area. They estimated, on the basis of this study, that this region consumed about 1,600,000 lb. of rabbit meat annually. Much of this meat is produced in the locality. There are rabbit butchers who send trucks on regular routes to collect rabbits from producers; the rabbits are brought into the city, dressed, packed in attractive boxes, and sold in retail food stores. But local supply does not keep pace with demand. California imports from 200 to 250 tons of rabbit meat annually.

Advantages of Rabbits for Meat Production

Fecundity is the secret of rabbit popularity to a very great degree; on the basis of this characteristic we have developed the expression *multiplying like rabbits.* In one year a good breeding doe may be expected to produce four litters. In each of these there may be six or eight rabbits. If we take the smaller number—and often there are more than eight in a litter—a doe may be expected to produce 24 young rabbits each year. If each of these rabbits grew to the size desirable for fryers (again we are counting our chickens before hatching and dressing them) and weighed 4 lb., this would mean that one doe would supply 96 lb. of live rabbit each year.

But since 50 per cent of this weight would be lost in dressing, we would have only 48 lb. of meat to put into the refrigerator or frying pan or broiler. If this meat were worth only 30 cents per pound, which is very cheap indeed at the ceiling price levels early in 1943, the total quantity of meat produced by one doe would be worth $15 each year.

Again doing some more or less theoretical figuring, this meat in costs of feed consumed would have been produced at an expenditure of $5 or more than $9 on the basis of feed prices in 1940. (Of course, we are interested in meat, not profits; ours is not a commercial enterprise; we do not expect to operate on a profit-making basis. But we do need to visualize the outlay and the possible return in the product—meat.)

The University of California, in the publication *Rabbit Raising*, says:

> The annual feed cost for a rabbit has been estimated at $3.50 to $3.75, and the cost of feed for one doe and her yearly increase of young at $5 to $9 in the state as a whole, $5 being a reasonable

figure. This includes the cost of feed until the young are about 2 months old. (Frying rabbits should weigh 3½ to 4 lb. when weaned and ready for market at 2 months of age.)

According to the enterprise-efficiency studies conducted by the Agricultural Extension Service, rabbits require a greater investment for each dollar gross income than poultry. As compared with poultry, rabbits require a smaller percentage of the total investment in land, about the same in buildings, but more in stock. On the basis of the returns of many persons engaged in rabbit raising, it may be assumed that a net return of $2 to $3 may be expected from every doe.

These figures are given on the basis of a long period of years but when feed prices were lower than they are at wartime levels. Meat, at the time the study was made, was not so high as it became later. The University of California is trying to point out that the growing of rabbits is not a get-rich-quick scheme. In fact, the pay earned by a rabbit producer is about 10 or 15 cents an hour.

It costs more to buy breeding stock to begin rabbit production than it costs to buy chickens. About the same expenditure is required for equipment, although a doe and her offspring may be kept in a box no larger than two orange crates. Feed costs are not very different.

Rabbits may be more interesting to keep than chickens, but this is a matter of personal opinion. Chickens have one or two decided advantages. They may be bought in any community. The feed they require is sold everywhere—even in most grocery stores. When trouble comes, as it will to all animal producers, there will be among the people living near by dozens who know how to take care of chickens for each one who knows anything about rabbits.

The hours of work involved in the two enterprises are about the same; if there is any difference, it is in favor of the rabbits. Chickens produce two products for home use, rabbits but one. Pigeons compare favorably with rabbits and chickens from all points of view. Perhaps the family preference in meat will be the deciding factor in making a choice.

Launching upon rabbit production involves several decisions. One of them is the breed to choose and the method of getting started.

Rabbits are kept for meat, fur, wool, hatters' pelts, show, and a variety of other reasons. There are 51 breeds of rabbits. Consequently, one must give some thought to the selection of a breed to keep in the back yard. At the moment, we are concerned only with rabbits for meat. While a great number of breeds will serve this purpose, the following are among the most popular meat breeds:

Breed	Standard weight, in pounds	
	Buck	Doe
Belgian hare	8	8
Chinchilla (American Chinchilla Giant and Rex)	10	11
Flemish Giant (Steel gray, light gray, black, fawn, sandy gray, white, blue and Rex)	14	15
New Zealand (Red and white)	10	11

The word *rex* in the above table has to do with the coat, in which the guard hairs (long hairs that normally stand out) are either shorter than the underfur or entirely absent. This is a matter of little concern to the individual interested in the production of meat for use at home.

It goes almost without saying that the beginner interested in the production of meat will buy one breed. It makes very little difference what that breed is, so long as the stock is healthy, in good condition in every respect, and prolific.

Convenience in purchasing may be the most important factor. If breeding stock can be purchased in the community, this is desirable; breed is a secondary consideration. In the breeding or raising of all kinds of stock it usually pays to select the breed most popular in the community or the state. This makes it possible to buy or exchange male and female animals with one's neighbors, or to buy them within a convenient shipping distance.

White breeds seem to be most popular. This is due not alone to appearance, but because the skins, in case one wishes to sell them, seem to bring a higher price.

The beginner may start with young rabbits just weaned, or with mature animals. Young rabbits have an advantage, if one has had no experience. During the time that they are reaching maturity the owner will learn something about their habits that will be useful.

Naturally, one will wish to begin on a small scale. Rabbits multiply so rapidly that the enterprise may be expanded in a short time, if one wishes to increase the scope of the enterprise. Perhaps it is desirable to buy one buck (male) and two does (females). A larger number of does may be purchased; only one buck will be required for each 10 does.

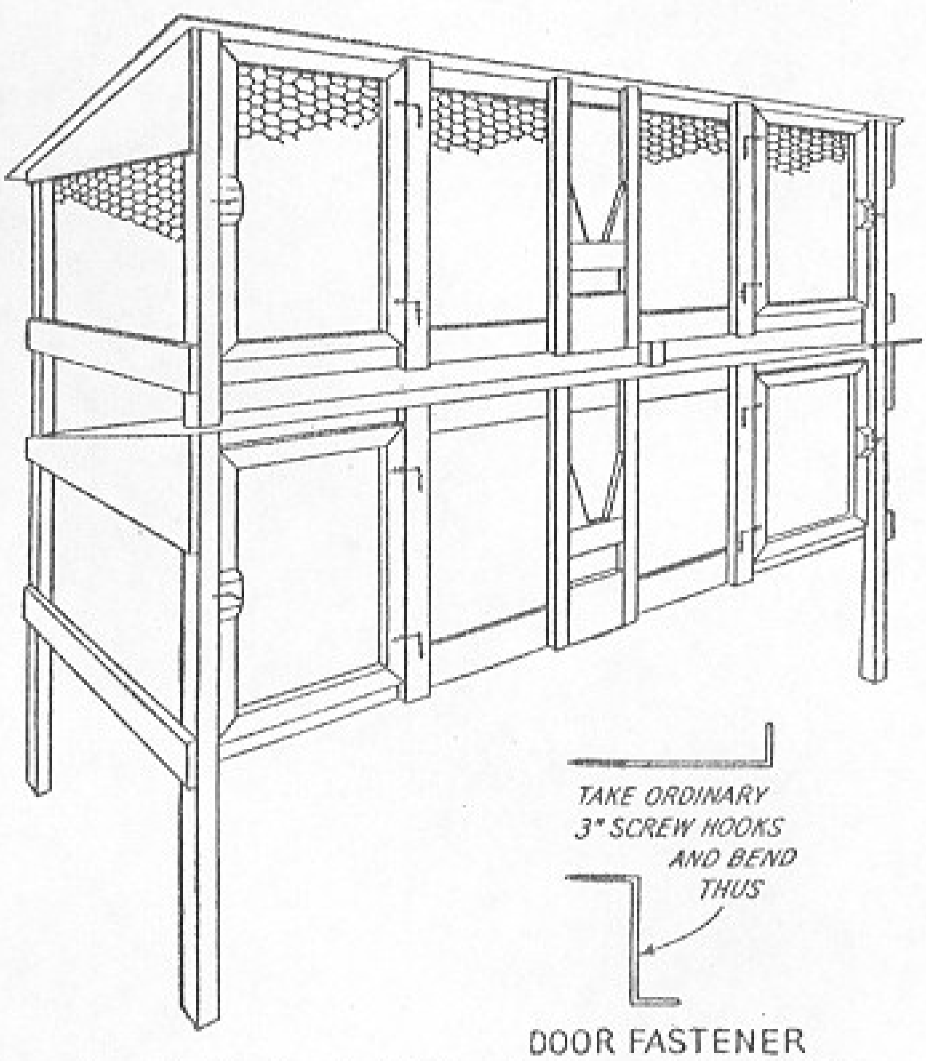
Doubtless there is a breeder in your locality from whom stock may be purchased. If not, the poultry department of your state college of agriculture can supply a list of breeders. Such information may be secured from the American Rabbit Breeders' Association, 7408 Normal Avenue, Chicago, or from the United Rabbit Experiment Station, Fontana, Calif. If necessary, rabbits for breeding stock may be shipped long distances by express.

Costs are less important than getting vigorous, young,

well-bred animals. When purchases are made from a breeder with a good reputation and a background of experience, the animals will be fully guaranteed as being good breeders or producers and free from disease. It should be stipulated in making purchases that *utility* is the primary consideration—not fancy points that interest only those who show rabbits as a hobby. It is desirable, if possible, to buy from an individual or a concern engaged in the business of producing and selling rabbits for *meat.*

Houses for Rabbits

Rabbits do not share community accommodations, as is the case with chickens. Nor do the sexes, in maturity, occupy a common apartment, as is the custom with pigeons. Each mother and father rabbit has a one-room domicile. A one-room rabbit house is called a hutch. A



A practical back-yard rabbit hutch. (*Farmers' Bulletin* 1730.)

collection of hutches is spoken of as a rabbitry. It makes little difference what sort of house a rabbit has, as far as the form is concerned. Only the space available is significant.

Hutches should be 2½ ft. deep, 2 ft. high, and 3 ft. long for the small breeds; 4 ft. long for the medium breeds; and 6 ft. long for the giant breeds.

Of course, rabbits should be protected from strong winds, cold weather, and rain. It is possible, however, in the warmer sections of the country and in the summer months that they may get too hot, since they have very thick fur coats. For this reason hutches are often placed under the shade of trees or on the cool side of a larger building. In the South, only a roof is needed; the sides of the hutch may be made of wire netting. The hutch may be placed inside a shed or building, but sunlight is desirable. It promotes better health and sanitation.

For one buck and two or three does—all that most families would require—small boxes of the size needed will serve quite well. There is no necessity for incurring more expense than the enterprise warrants, especially at a time when building materials, including nails and metals, are difficult to secure. Old boxes that will suffice may be picked up at retail stores.

All-metal hutches are recommended. But unless used hutches of this type can be bought, it is out of the question, when metal is on priority, to plan for the construction of an all-metal rabbitry. Metal is desirable because rabbits tend to eat other materials with which they are confined.

For as many as four or six hutches, especially if available space is limited, it is customary to build in tiers—say, two hutches high and two wide, for four rabbits; two wide and three high, for six. Any desired arrangement may be made, but such an arrangement is convenient. It occupies a ground space only about 3 by 8 ft. for the smaller rabbits and 3 by 14 ft. for the giant breeds. Between the hutches, a V-shaped opening in front provides a place for inserting hay without opening the doors of the pens. Also, provision may be made for inserting the feed on trays that operate just like drawers in a dresser, except, of course, that the top of each is open. These, however, are not necessary; pans filled with feed may be put into the pens through the screen doors at the front of the hatch.

A 4- to 6-compartment tier-type rabbitry will cost from $20 to $30, depending upon prices for materials and labor. The following materials will be required for a double-deck, 4-compartment unit.

Lumber:
- 2 pieces, 1¾ by 1¾ by 29 in.—for front corner posts. (If legs are desired, the pieces should be 59 in. long.)
- 2 pieces, ¾ by 2¾ by 29 in.—for door jams.
- 2 pieces, ¾ by 2 by 29 in.—for manger front.
- 2 pieces, ¾ by 0 by 2 by 7 in.—for triangular manger front.
- 1 piece, ¾ by 5¾ by 7½ in.—for manger front.
- 1 piece, ¾ by 2¾ by 7½ in.—for manger front.
- 2 pieces, 1¾ by 1¾ by 21 in.—for rear corner posts. (If legs are desired, the pieces should be 59 in. long.)
- 1 piece, ¾ by 5¾ by 21 in.—for manger rear.
- 1 piece, ¾ by 2¾ in. by 7 ft. 8 in.—for top front.
- 1 piece, ¾ by 5¾ in. by 7 ft. 8 in.—for top rear.
- 3 pieces, ¾ by 3¾ in. by 7 ft. 8 in.—for bottom.
- 2 pieces, ¾ by 1¾ by 9¾ by 34 in.—for top ends.
- 2 pieces, ¾ by 3¾ by 34 in.—for bottom ends.
- 2 pieces, ¾ by 2¾ by 17 in.—for crock supports.
- 2 pieces, ¾ by 4¼ by 11¼ by 31¾ in.—for manger top.

1 piece, ¾ by 1¾ by 32½ in.—for manger bottom.
1 piece, ¾ by 4¾ by 32½ in.—for feed-trough track.
4 pieces, ¾ by 1½ by 25 in.—for vertical doors.
4 pieces, ¾ by 1½ by 20 in.—for horizontal doors.
2 pieces, 1 by 1½ by 4 in.—for door-latch blocks.

Galvanized iron:
2 pieces, 24 gage, 1¾ by 30 in.—for feed-trough guards.
2 pieces, 26 gage, 36 in. by 8 ft.—for roof.

Miscellaneous:
1 piece, ⅝-in.-mesh, 17-gage galvanized hardware cloth, 30 in. by 8 ft.—for floor.
1 piece, ¾-in.-mesh, 16-gage poultry netting, 24 by 36 in.—for manger.
1 piece, 1-in.-mesh, 18-gage poultry netting, 24 in. by 8 ft.—for front and doors.
1 piece, 1-in.-mesh, 18-gage poultry netting, 18 in. by 14 ft.—for back and ends.
4 hinges.
2 door latches.
Fourpenny box nails—for front, rear, and roof.
Eightpenny box nails—for posts, ends, and bottom.
Poultry-netting staples.

A nest must be provided for each doe. An empty nail keg will serve the purpose, if holes are bored in the closed end for ventilation, and the open end is partially closed with a board, which, incidentally, will help to hold the keg in place. Boxes, 12 by 16 in. may be built to serve as nests. These boxes may be closed on all sides except for an opening 6 by 6 in. in one of the upper corners on the front. Metal strips on the corners will keep the doe from eating the nest.

Self-feeders of the desired size, like those built for pigs or pigeons or chickens, may be constructed; but they are hardly worth while in the opinion of most producers of meat for home use.

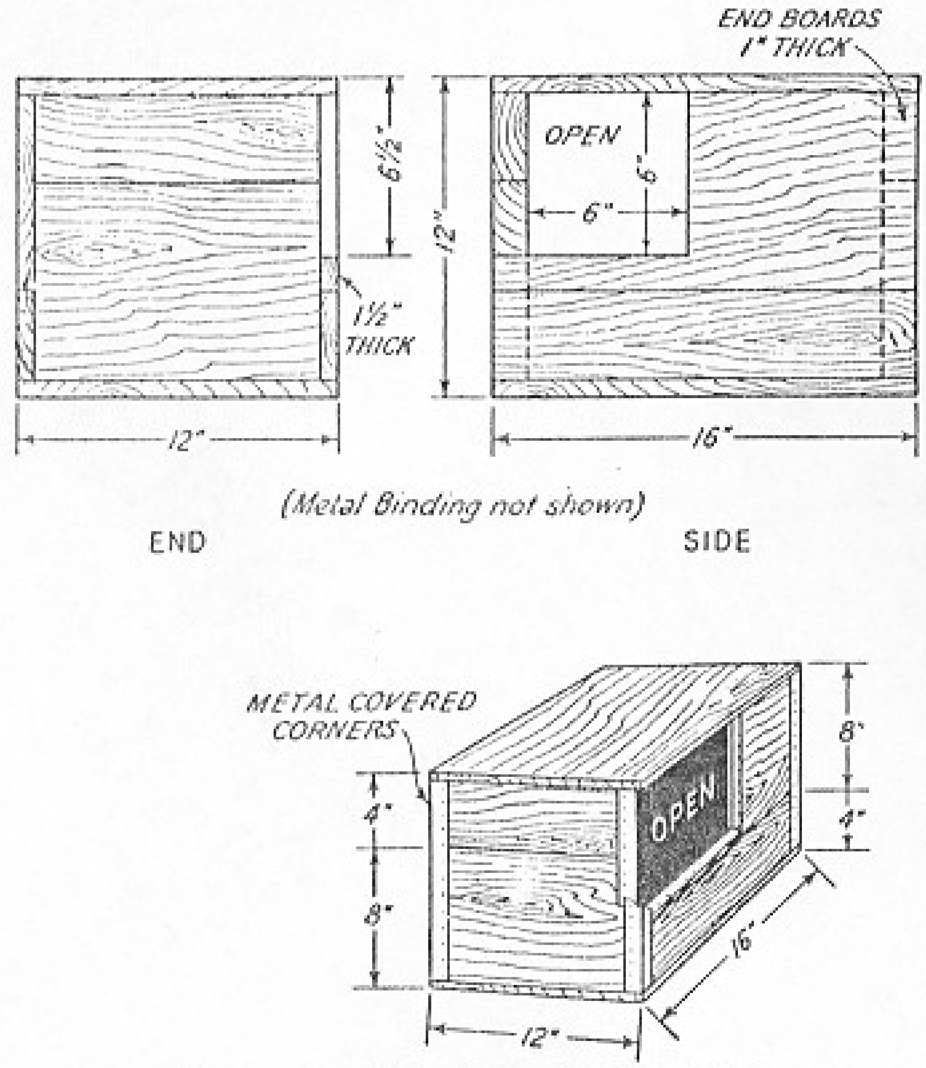
Rearing pens may be useful for young weaned rabbits. These are wire-covered frames about 2 ft. high and as large as one wishes to make them. Young rabbits in such pens get sunshine and also green feed. The pen may be moved about in the yard.

Simplicity should be the keynote for the beginner. Circumstances may be such that he will not wish to carry on the project except for a short time; or experience will bring a better basis for determining the equipment most desirable.

Breeding the Doe

Does should be mated young. It is best to breed them first about the time they reach maturity. If mating is delayed, it is sometimes difficult to get the females bred, and this defeats the purpose of the whole undertaking.

Age for breeding will be determined by the individual rabbit and by the kind or breed. The smaller breeds mature earlier than the larger ones. On the average, the smaller breeds are ready for mating at 5 or 6 months; the larger ones, however, may not reach the proper stage of maturity until attaining the age of 9 or 12 months. Does indicate readiness for mating by restlessness. The doe is always taken to the hutch of the buck for breeding.



Nest box for rabbits. (*Farmers' Bulletin* 1730.)

In rabbits the gestation period is 31 or 32 days—that is, the young should be born about 1 month after the doe has been served. The process of bearing young in rabbits is spoken of as *kindling*. The doe may not "catch" from the first service. To make sure that a doe is pregnant, she may be returned to the hutch of the buck several days following her former visit, and again on the eighteenth day. When females are about to kindle, they will "pull fur" to make a nest.

Young rabbits are weaned at about the age of 2 months. After the litter is weaned, the doe is bred again. If this schedule is followed, four litters may be produced each year. But for such production, the does must be kept in good physical condition. If on weaning a litter the doe is thin and not in vigorous physical condition, breeding may be delayed until she has been given a period of physical conditioning. Rabbits must never be allowed to get too fat. Animals that are fat are sluggish; they never breed well. But a female gaining in weight is much more likely to "catch" with the first service than one that is thin and emaciated or losing in weight.

Rabbits should not be inbred over a long period of generations; that is, production lines should not over a long period of time be confined to one family. It is advisable for the person producing rabbits to get a new buck occasionally—not closely related to the does. Too much

inbreeding reduces vigor and vitality. Animals that are not fertile and prolific should be discarded.

Does should not be disturbed just before kindling. The prospective mother should be supplied with plenty of fresh water and straw or some nesting material. Just before bearing young, the mother will make a nest and line it with fur from her own body.

The young are born naked and with their eyes closed. Incidentally, this is the distinguishing characteristic between the true rabbit and the *hare*. In the latter, the young are born with some covering and with their eyes open. New-born rabbits may get too hot. Often the mother may wrap them with such a covering of fur that infant mortality will follow unless some of the fur is removed. The season of the year and the temperature will serve as a guide to the owner as to whether some of the fur should be removed from the nest.

Rabbits usually have eight nipples; some, including the Belgian hares, may have six. Each young rabbit should have a nipple of his own. Should the litter contain too many rabbits, the number must be reduced. A litter of six will usually weigh as much at 2 months of age as a litter of eight. Well-fed rabbits grow rapidly. White New Zealand rabbits, for example, should reach a weight of 4 lb. in 56 days. Rapid growth is always desirable; it improves the quality of the meat and reduces feeding costs.

Feeding Rabbits

Rabbits must have feeds of good quality. Moldy, dusty, or mildewed feeds will produce digestive troubles. Unless good health is maintained through good feed and proper sanitation, disease will destroy the enterprise.

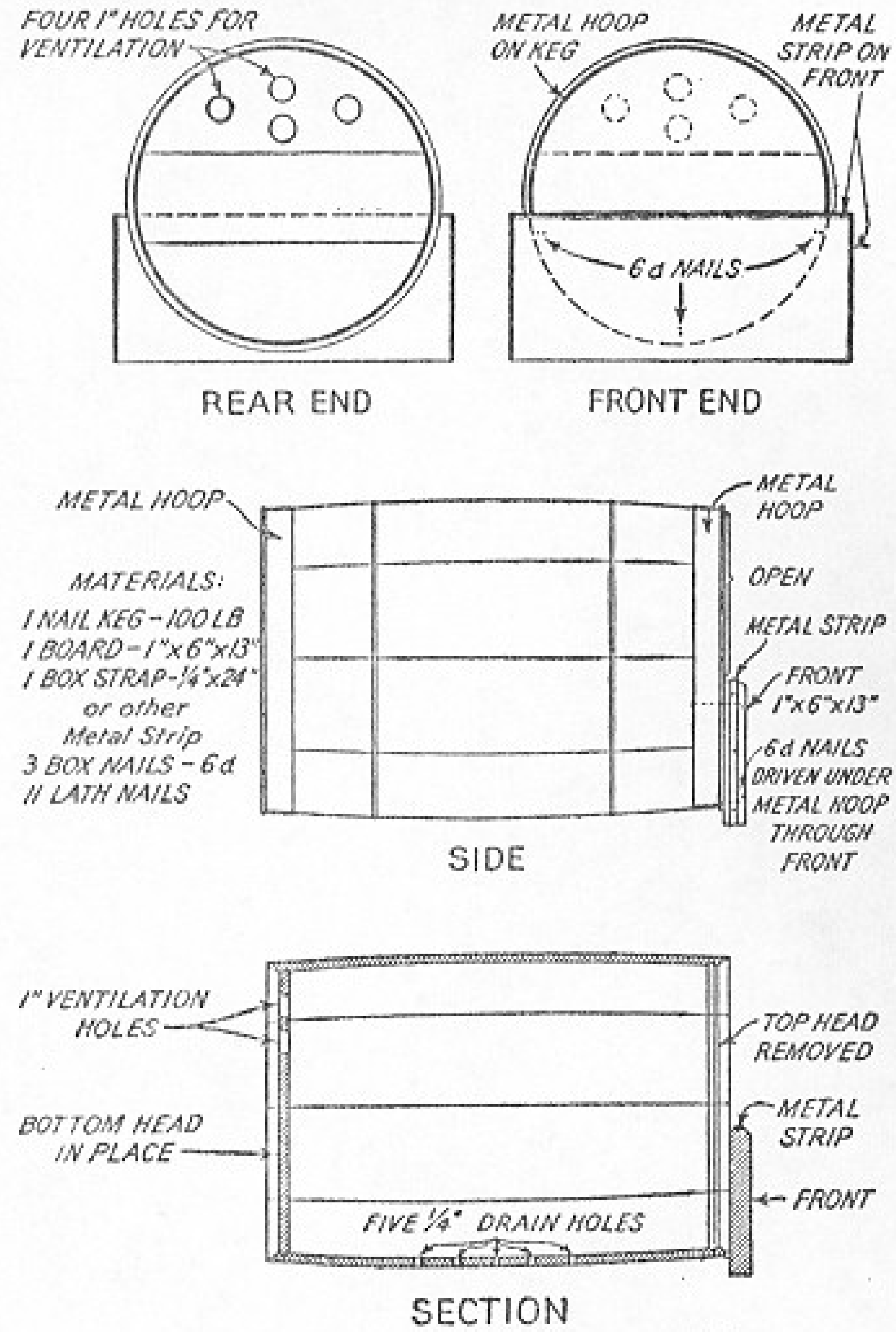
To supply all required nutrients, a variety of feeds must be used in the ration. Variety stimulates consumption and leads to rapid growth.

Feeds for rabbits may be classified under four heads: *roughage*, *concentrates*, *salt*, and *water*. It seems absurd, but every principle that applies to feeding a cow may be followed in feeding a rabbit. The only difference is the quantity involved.

The term *roughage* includes all coarse feeds, such as hay and grass. *This is the natural feed of a rabbit.* It must be supplied in abundance.

Legume hays are recommended. A legume, you know, is a plant that gathers nitrogen from the air and stores it in little nodules on the roots. Such plants not only improve the soil on which they grow, but are more nutritious feeds than are other classes of plants.

Alfalfa is the best hay for rabbits in the opinion of most owners. Other legume hays may be used including clover, lespedeza, sweet clover, cowpea, vetch, kudzu, soybean, and peanut. The kind of legume hay is not so important



Barrel nest for rabbits. (*Farmers' Bulletin* 1730.)

as the quality. The best hay has many leaves and small stems. It is bright green in color, not dark brown. Green hay contains vitamins; brown hay has lost not only its vitamin content but other nutrients.

Hay may be bought in bales. This is a convenient form for use and storage. For feeding rabbits the hay should be cut into pieces not more than 3 or 4 in. long. Unless this is done, much of it will be wasted. A rabbit will pull a long piece of hay out of the manger, eat a bit, and discard the greater part for another fresh piece from the manger. Some method of cutting the hay may be developed that will not require much time. If only two or three rabbits are to be fed, it may be cut with pruning shears. Commercial producers have large knives, something like crosscut saws, with which they cut the baled hay. It can be chopped with a hatchet, or cut with a saw.

Rabbits should have hay available at all times.

Green crops are included in the classification of roughage. These are of two kinds: leafy plants and roots. Leafy plants include grass, weeds, cabbage, lettuce, garden waste, and other such things. Rabbits like such feed. They also like such root crops as carrots, sweet potatoes,

turnips, and mangels.

While it is impossible for rabbits to get too much hay, one should use care in feeding green crops. If they are added to the ration in too large quantities, digestive disorders will result. A very little green feed should be given the first time it is introduced in the ration. The quantity may be increased a little at a time. But since such feeds are readily available during the summer and fall, they should be used as far as it is possible to do so.

Concentrates are of two kinds: cereal grains and protein supplements. In the diet of a human being these are bread and meat. The grains are starchy, carbohydrate feeds; in these are energy feeds. The protein, or tissue-building material, is supplied by the so-called "supplements." More grains than protein supplements are required. The grains are quite common; they are grown extensively everywhere. For the most part, they are fed whole; rabbits do not thrive on finely ground feeds, as do chickens. Corn, when fed to rabbits, should be ground; otherwise, the rabbits will eat only the germ and discard the greater portion of the kernel.

Protein supplements are fed in the form of pellets or pills. Rabbits like to chew these feeds.

The Department of Agriculture recommends the following mixtures of concentrates:

For Dry Does, Herd Bucks, and Developing Rabbits

Mixture 1

2 parts whole oats
1 part whole wheat
1 part whole-grain sorghum or barley
1 part pea-size soybean or linseed cake, or pelleted soybean, peanut, sesame, or linseed meal

Mixture 2

2 parts whole oats
2 parts whole wheat
1 part pea-size soybean or linseed cake, or pelleted soybean, peanut, sesame, or linseed meal

Mixture 3

2 parts whole-grain sorghum seed
2 parts whole barley
1 part pea-size soybean or linseed cake, or pelleted soybean, peanut, sesame, or linseed meal

Mixture 4

1½ parts rolled oats
1½ parts rolled wheat or barley
1 part corn meal
1 part soybean, peanut, sesame, or linseed meal

For Does and Litters

Mixture 5

2 parts whole oats
1 part whole wheat
1 part whole-grain sorghum or barley
2 parts pea-size soybean or linseed cakes, or pelleted soybean, peanut, sesame, or linseed meal

Mixture 6

1 part whole oats
1 part whole wheat
1 part pea-size soybean or linseed cake, or pelleted soybean, peanut, sesame, or linseed meal

Mixture 7

1 part whole-grain sorghum seed
1 part whole barley
1 part pea-size soybean or linseed cake, or pelleted soybean, peanut, sesame, or linseed meal

Mixture 8

1 part rolled oats
1 part rolled wheat or barley
1 part corn meal
1½ parts soybean, peanut, sesame, or linseed meal

A study of these mixtures will reveal that three fundamental principles have been followed:

1. Every concentrate includes two or more grains or cereals.
2. Every concentrate includes one protein supplement.
3. The protein supplement is increased in the ration of does with young.

If these principles are followed, satisfactory results may be obtained. The ingredients may be purchased at any feed store; they may be mixed at home or at the feed store, as one prefers.

Bread and table scraps—other than fat meat—may be fed. This will cut feed costs.

Water must be supplied so that it is available at all times. A crock is used as a water container—a flat-bottomed crock. A doe and her litter will drink a gallon of water during a summer day.

Salt is essential. It is best supplied by placing a piece of block salt in the hutch.

Rabbits should be fed morning and night, at the same hours each day. They eat more at night than during the day.

Young rabbits should be left with the doe. In the proper time, they will be weaned. The milk supply will decrease, and the young rabbits will learn to eat the feed put in the manger and feed troughs.

Rabbits should not be handled any more than is absolutely necessary.

To aid in promoting health and preventing disease rigid rules of sanitation must be practiced. Manure, soiled bedding, and discarded feed should be removed from the hutch daily. Feed troughs and water crocks must be kept clean. This equipment should be washed often in hot water with soap—then rinsed and placed in the sun to dry. Sunshine destroys disease germs. Nests should be cleaned before being used a second time. Occasionally, the hutches must be cleaned (removing the rabbits) and disinfected with a coal-tar

product. Be sure that they are dry before the rabbits are replaced.

Sanitary measures and good feed will tend to keep down disease. But if a rabbit becomes sick it should be put off in a box or hutch apart from the herd. If it does not get well, it should be killed.

Dressing and Serving

Dressing rabbits is a simple task. If the skin is broken on the back near the shoulder so that one's fingers may be inserted, the skin may be peeled off easily. Then, if the membrane on the front is cut from one end to the other, the waste can be removed and the carcass left clean. (We are assuming that persons raising rabbits for meat are not interested in the pelt.)

Most rabbits marketed or used at 8 to 10 weeks of age are sold as *fryers* or *broilers*. Older rabbits may be served in fricassees, casserole dishes, pie, and other ways comparable to those used for older fowls and the less tender cuts of meat.

In color, flavor, and taste domestic rabbits are superior to the wild cottontail. All the meat is white. In food value, it is about like chicken. It is a good source of protein.

The Bureau of Home Economics gives the following recipes for the cooking and serving of domestic, hutch-raised rabbits:

Broiled Rabbit

Select a young rabbit. After dressing, wipe the meat with a clean, damp cloth, and rub with salt, pepper, and flour. Lay the rabbit whole, back down, on a rack in an uncovered roasting pan, and place generous pieces of butter or other fat in the hollow places, but do not add water. Cook in a moderate oven (350°F.) for 40 to 50 min., or until tender. Turn the rabbit over, baste with the pan drippings, and place under the flame of the broiling oven to brown. Cut into pieces for serving, place on a hot platter, and pour on the drippings mixed with finely chopped parsley.

Fried Rabbit

Wipe with damp cloth and cut into pieces for serving. Beat one egg yolk, add ½ cup of milk and ¾ teaspoon salt, and stir into ½ cup flour to make a smooth batter. In a heavy skillet, heat 4 tablespoons of fat until very hot, so it will set batter quickly. Dip a piece of rabbit into batter and drop into the hot fat. As soon as browned, reduce heat and cook at moderate temperature for 25 to 30 min., or until the meat is tender. Serve on hot platter and garnish with parsley.

For each cup of gravy desired, use 2 tablespoons of pan drippings and 1½ tablespoons of flour. Blend fat and flour in skillet, add 1 cup of milk, and stir until thickened. Add chopped parsley, salt, and pepper to season.

Rabbit en Casserole

Wipe the rabbit meat with a damp cloth, cut into pieces for serving, sprinkle with salt and pepper, and roll in flour. Brown lightly in hot fat in a skillet, transfer to a casserole, add some of the fat from the skillet and ½ cup of hot water. Cover and cook in a moderate oven (350°F.) for 1½ to 2 hours, or until the meat is tender. Remove the meat, and thicken the gravy slightly. To each cup of liquid allow 1 tablespoon of flour, mix with a few tablespoons of cold water, add to the meat drippings. Return to the oven, and stir occasionally until thickened. Season with salt and pepper and finely chopped parsley, replace the meat, and when thoroughly hot serve in the casserole.

Smothered Rabbit

Wipe the rabbit meat with a damp cloth, and cut into pieces for serving. If the rabbit is not young and tender, barely cover with hot water, and simmer for about one hour in a partly covered kettle. Transfer the meat to a shallow baking dish, and cover with a sauce made of 1 cup of the broth and 1 cup of milk thickened with 4 tablespoons of butter or other fat blended with 2 tablespoons flour, and salt and pepper to season. Bake in a moderate oven (350°F.) for about ½ hour, or until the meat is tender, and serve in a baking dish.

Young rabbit to be cooked in this way needs no parboiling, but may be put directly into the baking dish, covered with 2 cups of the thin sauce made with milk, and baked until tender.

Rabbit Pie

1 rabbit	3 tablespoons butter or other fat
½ teaspoon salt	Flour
1 onion, chopped	Dash of tobasco sauce
1 green pepper, chopped	Pastry
½ cup chopped parsley	

After wiping the meat with a damp cloth, cut into two or three pieces. Place in a kettle, barely cover with hot water, add the salt, partly cover the kettle and simmer until tender, or about 1½ to 2 hours for a mature rabbit. Drain and measure the broth, and remove the meat from the bones in large pieces. Cook the onion, green pepper, and parsley for a few minutes in the fat in a skillet and stir frequently. For each cup of broth measure 1½ tablespoons of flour and mix well with the fat and seasonings. Add the broth and stir until thickened. Add more salt if needed and a dash of tobasco sauce. Mix well with the rabbit meat and pour into a baking dish. Cover with pastry and bake in a moderate oven (350°F.) until the crust is golden brown.

Rabbit à la King

1 rabbit, or 3 cups diced cooked meat	2 egg yolks
2 cups cream	1 teaspoon minced onion
4 tablespoons butter	1 tablespoon lemon juice
2 tablespoons flour	Paprika
1 green pepper, chopped	Salt
1 lb. mushrooms, cut in pieces	½ cup chopped pimientos

A rabbit past the broiling and frying age can be used to excellent advantage in this way. Wipe the dressed rabbit with a damp cloth, place on a rack in a kettle, add ½ teaspoon salt, barely cover with hot water, partly cover the kettle, and simmer for 1½ to 2 hr., or until the meat is tender. Let cool in the broth, then drain, remove the meat from the bones, and cut into even pieces.

Heat the cream in a double boiler. Blend the flour with 2 tablespoons of the butter, and stir into the cream until thickened. Melt the remaining butter in a skillet, add the green pepper and mushrooms, and cook for a few minutes over low heat. Beat the egg yolks, stir a small quantity of the thickened cream into them, and add to the rest of the sauce. Also add the mushrooms, green pepper, onion, and lemon juice, with paprika and salt to taste, add the diced rabbit

and pimiento. When the mixture is heated thoroughly, serve in patty shells or on crisp toast.

Sources of Information

Persons engaging in rabbit production will wish to secure information as the enterprise progresses. After a little experience, literature will become more interesting; also, it will prove to be an aid in time of trouble.

The U. S. Department of Agriculture maintains a Rabbit Experiment Station at Fontana, Calif. Here, on the site of a 5-acre orange grove, about 4,000 rabbits are produced each year. This station publishes literature dealing with the industry. It supplies information on request. Officials in charge will be glad to answer individual inquiries.

The U. S. Department of Agriculture, Washington, has published several bulletins of interest, including the following: "Rabbit Production" (*Farmers' Bulletin* 1730); "Rabbit Parasites and Diseases" (*Farmers' Bulletin* 1568); "Rabbit Recipes" (*Leaflet* 66).

Several periodicals are devoted entirely or in part to rabbit production; among them the following are suggested: *American Rabbit Journal* (Warrenton, Mo.), *Small Stock Magazine* (Lamoni, Iowa), *Western Rabbit World* (Van Nuys, Calif.).

Any inquiry about rabbits, including breeders from whom stock may be purchased, may be directed to American Rabbit and Cavy Breeders' Association, A. Weygandt, Sec., 7408 Normal Avenue, Chicago, Ill. Also, this association has available a book of interest to breeders of fine stock called the "Guide Book and Standard for Rabbits and Cavies." A cavy, by the way, may be any one of a number of little animals—the guinea pig, for example.

Several state agricultural colleges and experiment stations have published bulletins dealing with rabbits. These institutions will usually respond to an earnest request and send a copy of the publication desired without cost. Among those dealing with rabbits that are very good indeed are the following: "Rabbit Raising," *Circular* 9, University of California, Berkeley; "Care of Rabbits," *Cornell Extension Bulletin*, Cornell University, Ithaca, N. Y.; "Domestic Rabbit Raising in Florida," *Bulletin* 6, Department of Agriculture, Tallahassee, Fla.; "Nutritional Requirements of Rabbits," *Bulletin* 219, Experiment Station, Columbia, Mo.

A number of books about rabbits have been published, including "The Rabbit Book," by F. L. Washburn (J. B. Lippincott Company, Philadelphia); "Rabbits for Food and Fur" by Frank G. Ashbrook (Orange Judd Publishing Co., Inc., New York); "Genetics of Domestic Rabbits" (Harvard University Press, Cambridge, Mass.).

A CHICKEN IN EVERY FRYING PAN

VICTORY BARNYARD, 1943
Paul W. Chapman

Meat, which is the backbone of army rations, is the main dish in any satisfying lunch or dinner. If you have meat, you can have gravy. And if you have gravy and bread, or gravy and potatoes—along with meat—you have a good meal. No other food satisfies hunger so well as meat. Of course, nutritionists would frown upon such a diet; they would insist, among other things, on adding green or yellow vegetables. But few nutritionists have ever been very hungry.

Meat is scarce. It was the first basic food we were asked to share. Supplies will decrease as long as the war continues, and perhaps for several years after hostilities cease. There are no more meat animals on American farms today than there were 25 years ago, and yet during the past quarter of a century our population has increased 30 per cent. With the money our people now have to spend, there is not enough meat to supply civilian demands, even if there were no war. But, in addition to abnormal needs on the home front, tons of this essential food must be sent overseas. Meat is essential to the prosecution of war; it is the fuel of fighting men.

To supply the requirements of our armed forces and our allies, soon after the war started Federal officials instructed meat packers to hold one-fourth the nation's total supply to fill government orders. Some authorities believe that within a short time these demands will make it necessary to withhold from civilian markets one-half the available supply.

When this shortage strikes with full force, what shall we do for meat? The answer is that millions of American people in towns and cities can, if they wish, produce a goodly proportion of their own meat. Of course, not many can keep a beef steer. And hogs are very offensive—to the neighbors. But of the 29 million families living in the United States, perhaps 15 million can grow chickens in the back yard. The techniques are amazingly simple, and most of us like chicken.

You may recall that Herbert Hoover once ran for president on the slogan, *A chicken in every pot*. It was a good slogan; the voters just did not believe that he could do it. Even today, under the stress of war, we cannot put a juicy hen, an oversized capon, or a young and tender rooster in every roaster. But we can put a fryer in every pan—once or twice a week.

Ideal Town or City Enterprises

Chickens are kept for two products—meat and eggs. The projects or enterprises through which these products are produced may have little or no relationship with each other. A family may engage in the production of young chickens for meat without becoming engaged in egg production at all. A flock of laying hens kept for egg production will, incidentally, supply some meat for the table as nonlayers are culled or as the older birds from year to year are replaced with young pullets. But the enterprises are quite separate and distinct. At the moment, let us concentrate upon the production of young chickens for meat.

There is no other meat-production enterprise in which town and city people may engage that is so desirable or appealing as the raising of broilers or fryers.

The great advantage that this enterprise has as compared with all others is the short period of time required to get in and out of the business, with one year's meat supply as the return for one's labor and investment.

A chicken weighing 1½ or 2 lb. may be produced in less than 12 weeks. It is possible for a town or city family to start a broiler project any month in the year, remain in the poultry business for 3 months, and then quit and forget about the whole thing for the other 9 months in the year—except, of course, as the chickens may be served from time to time. Such a plan contemplates killing, dressing, and storing all the fryers and broilers when they attain the desired weight. Of course, carrying out such a program involves the use of some storage facilities for the dressed poultry, which will be discussed later; just now, however, we wish to concentrate upon the job of producing meat for home use.

City families may produce their own meat by keeping pigeons or rabbits. Both enterprises lend themselves ideally to a city back yard, but both involve a year-round production job. A pig will supply a goodly portion of the family's meat requirements and may be fed largely on table scraps. Also, a pig may be bought when 3 months old, kept for 3, 5, or 7 months and butchered. This is an ideal project in many respects, but it has one disadvantage—hogs are not always welcome residents of congested areas. On the other hand, chickens are seldom offensive to one's neighbors.

By building in the back yard, a small brooder, which will occupy very little space, 150 lb. of chickens—or any quantity desired—may be produced easily. Also, city families that move to the country during the summer months may produce their chickens while on vacation and take the dressed poultry back to the city for storage.

Producing young chickens for meat has other advantages. Hatcheries and feed stores are so widely distributed that baby chicks and feed may be obtained in every community. Information concerning the growing of chicks is universal; a much smaller number of people have had experience in the production of rabbits and pigeons.

Another distinct advantage of the broiler business is that one may make it a continuous process; that is, as soon as one brood of chicks has been raised and consumed, another may be started. The project or enterprise may be repeated as many as three or four times each year. Such a plan makes it possible to serve home-grown fried or broiled chicken every month in the year.

Now for some production details!

When may the enterprise be started? A broiler project may be started at any time. It makes very little difference when one starts. There isn't a month in the year unfavorable for launching a baby-chick project. Of course, if one has a very small lot and neighbors close by, it may be best to avoid the hot months of summer, as a slight odor will develop in spite of one's best efforts to observe all sanitary precautions. However, if a little discarded crankcase oil is sprinkled on the brooder floor, that will help. Also, acid phosphate (a commercial fertilizer) may be placed on the floor and, when removed with the droppings, will make a very rich source of plant food for the garden.

How does one get started? There is only one practical way—to buy day-old baby chicks from a commercial hatchery. Hatcheries are widely distributed, as one will learn by consulting the classified section of the telephone directory.

And in buying chicks from a hatchery there are two very important considerations to remember.

First, buy only the heavy breeds. Among these breeds are included, for example, Plymouth Rocks, Rhode Island Reds, or New Hampshires. Most commercial poultry flocks are maintained for the production of eggs. Leghorns are conceded to be the best layers, but they are too small to make the best birds for meat.

Second, buy only chicks from pullorum-tested flocks. Chicks from such flocks will be disease-free, so far as this is possible; they will have high viability. Hatchery operators will tell you whether their chicks are from tested flocks. Or, if you like, you may write to your state college of agriculture and secure a list of your local hatcheries that are pledged to operate only under the standards and regulations of the National Poultry Improvement Plan, which ensures high-quality stock. The chicks will cost about 12 cents each; naturally, there will be variations in price.

How many day-old chicks should one buy? Two considerations will determine the number to buy—the number of frying-size chickens desired by the family and the available brooder space. Of course, the brooder accommodations may be provided with the view of producing the number of chickens required.

Of all the brooders used to provide chickens for home use, the outdoor, lamp type is most universally recommended. The size of this brooder may be changed as one wishes. But the standard size will accommodate 100 baby chicks. When the chickens attain a weight of 1 lb. or more, the brooder becomes too small. Therefore, it is suggested—if this type is used—that one start with 60 chicks; or, that one begin with 100 chicks, provide two brooders, and divide the chickens into two lots when they are about 6 weeks old.

Brooders for Baby Chicks

The brooder is the only essential equipment for conducting the broiler project. Three types of brooders may be used. We will call these the (1) *homemade lamp type*, (2) *electrically heated hover type*, and (3) *brooder-house unit type*. The first two are designed for small flocks ranging from 60 to 200 chicks. The third is designed for larger flocks ranging from 300 to 500 chicks.

The homemade lamp-type brooder was originally designed by the Extension Service of [illegible]ana State University. It has become very popular. One agency of the Federal government built 50,000 in 1942. It is used in all parts of the United States. This brooder may be described as a one-room house with a basement and a screened porch. The basement, with no floor other than the ground upon which the brooder rests, is the furnace room. Here the heating unit, whatever it is, may be installed. A No. 2, wall-type lamp, burning kerosene, is recommended. This is the best source of heat. But if a lamp and kerosene are not available, electric bulbs—two of 100 watts—may be used. If heated with electric bulbs, the house must be insulated; that is, the cracks and walls must be covered with cloth or some other material that will keep out the cold and wind. To heat the house for 10 or 12 weeks, 5 gal. of kerosene will be required.

The floor of the house, where the chicks live much of the time, has a metal floor covered with sand. These materials spread and hold the heat. The room is 3 ft. wide and 4 ft. deep. Any kind of lumber may be used in construction.

After they are a few weeks old, the chicks, when it is not too cold, may be allowed to leave the house and wander round the back yard. But the practice is not recommended. It is assumed that the chicks will never leave the brooder from the time they are put in it until they are removed for killing and dressing; hence, the screened-in porch.

The porch, with wire (1-in. poultry mesh) on all sides, has a floor of hardware cloth. Here the chicks may get the sun on warm days and take their meals when the weather is pleasant. During cold and wet weather, they will eat inside the house. The porch is 3 ft. wide and 6 ft. long.

The entrance—connecting the house and the porch—may be left open in warm weather. When it is cold, a heavy cloth, with convenient slits facilitating entrance and departure, may be provided. No specific temperature is required; when quiet, the chicks are comfortable. They must not get too hot. Little holes, bored with an auger on all four sides of the house, provide ventilation.

Here is a list of the materials required for building the brooder:

Lumber (all given in linear feet): 2 × 2, 10 ft.; 1 × 2, 13 ft.; 1 × 4, 120 ft.; 1 × 8, 3 ft.; 1 × 10, 24 ft.; 1 × 12, 28 ft.

Hardware cloth (for covering porch floor): 3 by 6 ft.

One-inch poultry mesh (for enclosing porch, all sides): 15 ft., 12 in. wide.

Hinges (for top of house): two 3-in.

Hooks and eyes (for fastening house and porch together): 4.

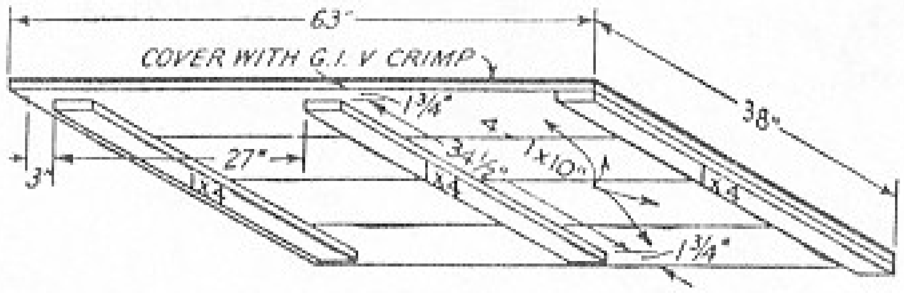
V-crimp galvanized iron (for covering top of house—sloping roof): 1 sheet 38 by 63 in.; also (for floor of house) 1 sheet 3 by 4 ft.

Also 2 lb. of sixpenny nails and 1 lb. of wire staples are required.

All these materials for the brooder, at present prices (early in 1943), cost about $5. For $12, almost any woodworking shop will build the brooder according to specifications.

Poultry specialists at the University of Georgia give the following information concerning the use of this brooder.

> The brooder is designed for raising a small number of chickens. It is ideal for the home flock. No brooder house is necessary; that is, the lamp-type brooder does not have to be placed inside a building or shelter, as is true of the hover-type brooders. It is easy to build; no critical materials are required.
>
> One hundred day-old chicks may be started, but the number should be reduced to 50 when 4 or 6 weeks old. If one wishes to raise 100 chicks, two brooders are recommended.
>
> The brooder may be heated with a No. 2 wall oil lamp, which is placed in the lower box. Vent holes are provided for supplying air. In very cold weather, two or even three lamps may be used to supply heat. About 5 gal. of kerosene will be required for each lamp used over the period required for brooding one lot of chicks.
>
> The brooding compartment in the rear has a metal bottom so that no wood is exposed to the flame of the lamp. The metal should be covered with clean river sand about an inch in depth. (For the first two days it is advisable to cover the sand with paper.) The lamp heats the sand and the chicks run on the warm sand. At least 24 hours before chicks are placed in the brooder the lamp should be lighted so as to allow time for the sand to dry thoroughly and a uniform temperature to be obtained in the brooding compartment. The lamp should be given careful attention and the wick cleaned once each day. With proper attention the lamp should not smoke.
>
> A 7-in. perforated curtain should be tacked on the opening leading into the screen pen during the winter season. When brooding in late



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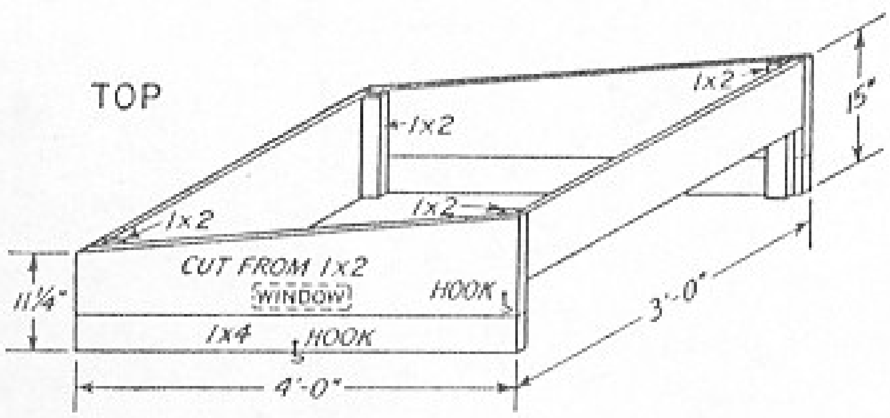
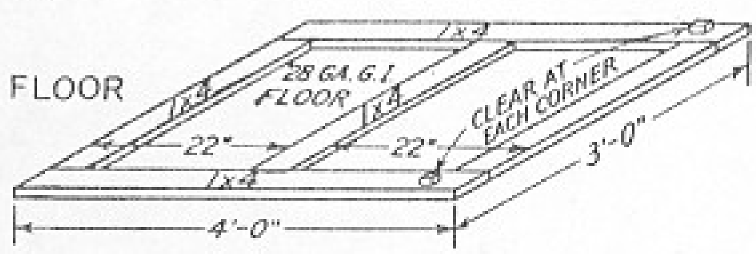
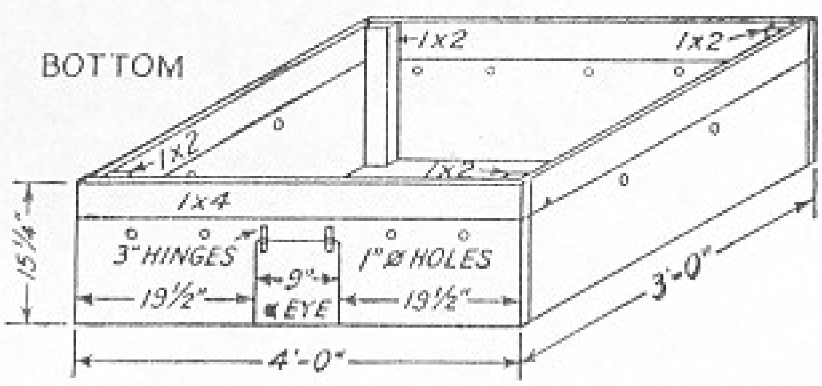
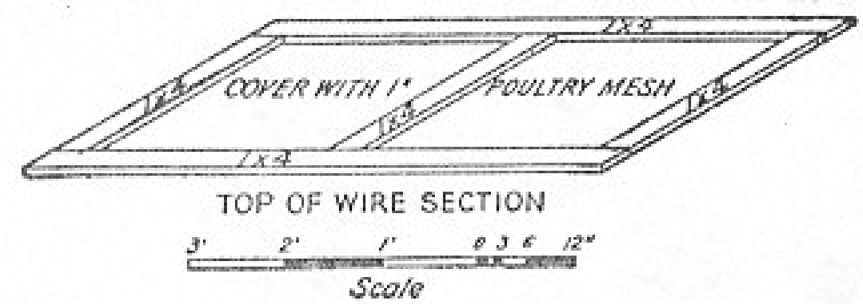
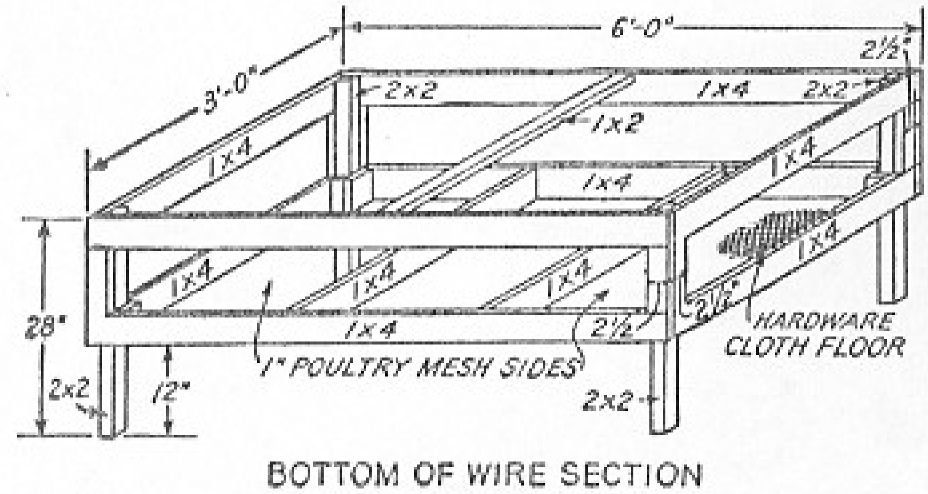
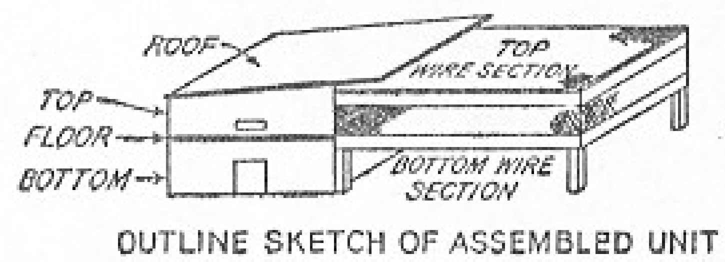












Homemade lamp-type brooder. Detailed plans for building. (*Georgia Extension Service.*)

spring the curtain should be removed and care taken that the chicks are not overheated. Several wood boards or a sheet of galvanized iron should be used as a cover over the runway during rainy weather, so as to protect the feed and water vessels. The top of the runway is cut and hinged so as to give ready access to this part of the brooder.

A small glass pane is located in the side of the rear compartment, which gives light when the chicks are fed there and also facilitates observation. After the first few days, feeders and waterers are placed in the runway.

This brooder has the advantage of keeping the chicks off contaminated ground, and thus helps to prevent diseases. The dry droppings in the sand in the rear compartment should be raked up each day. It is not usually necessary to change this sand more than two or three times during the brooding period, unless rain beats in and gets the sand wet.

This brooder plan has enjoyed enormous popularity. When cost must be held to a minimum, or when only a limited number of chicks are to be brooded, this small portable unit is especially recommended.

The lamp-type brooder, as compared with other types, has the following advantages:

1. It is a complete unit; that is, it may be placed outdoors in the back yard, not inside a building.
2. All material for construction is readily available.
3. It can be made at home by anyone handy with tools.
4. It provides living quarters for chicks from beginning to end of the broiler project.
5. It is both house and yard.
6. It may be used any place, town or country, since heat is supplied by a kerosene lamp.
7. It safeguards the health of chicks by keeping them off the ground, which may be a source of contamination.

It is believed that the majority of back-yard producers will prefer the lamp-type brooder. But some will, of course, wish to use one of the other types.

Electrically Heated Hover-type Brooder

If a shed, garage, or other building is available, the electrically heated hover-type brooder may be preferred. This is a square box without a bottom. It is placed on the floor. The box is 12 in. high. The upper half on all four sides is solid board; the lower half is a curtain with slits or openings through which the chicks go in and out of the brooder. The electric heating unit is fastened to the inside of the top. The cord connected with the heating unit is plugged into a wall socket. Automatic heat regulation is provided.

The brooder may be made in any size. Specifications

are given for the 100-chick size (30 by 30 in.), and for the 200-chick size (48 by 48 in.).

Bill of Material

Item	Quantity	Description
		100-*chick Capacity—Size* 30″ × 30″
1	1 piece	¼- by 30- by 30-in. plyboard
2	1 piece	½- by 30- by 30-in. Celotex or equivalent
3	10 lin. ft.	½- by 5½-in. Celotex or equivalent
4	10 lin. ft.	1- by 6-in. board (dressed)
5	4 lin. ft.	2- by 2-in. board (dressed)
6		Assorted box nails and roofing nails
7	8	⅛- by 2-in. round-head stove bolts and nuts
8	8	⅛-in. flat washers
9	1	Heating assembly (minimum of 225W-115V)
10	1	Brooder thermometer
11	11 lin. ft.	6-in. brooder curtain
		200-*chick Capacity—Size* 48″ × 48″
1	1 piece	¼- by 48- by 48-in. plyboard
2	1 piece	½- by 48- by 48-in. Celotex or equivalent
3	16 lin. ft.	½- by 5½-in. Celotex or equivalent
4	16 lin. ft.	1- by 6-in. board (dressed)
5	4 lin. ft.	2- by 2-in. board (dressed)
6		Assorted box nails and roofing nails
7	8	⅛- by 2-in. round-head stove bolts and nuts
8	8	⅛-in. flat washers
9	1	Heating assembly (minimum of 450W-115V)
10	1	Brooder thermometer
11	17 lin. ft.	6-in. brooder curtain

Items 1 to 8 in the bills of materials listed may be purchased from local lumber dealers. Numbers 9, 10, and 11 must be ordered. Perhaps they will be available through your local power company; they may be purchased from a poultry feed and supply store. Or, the names of the manufacturers can be obtained from your local county or home demonstration agent.

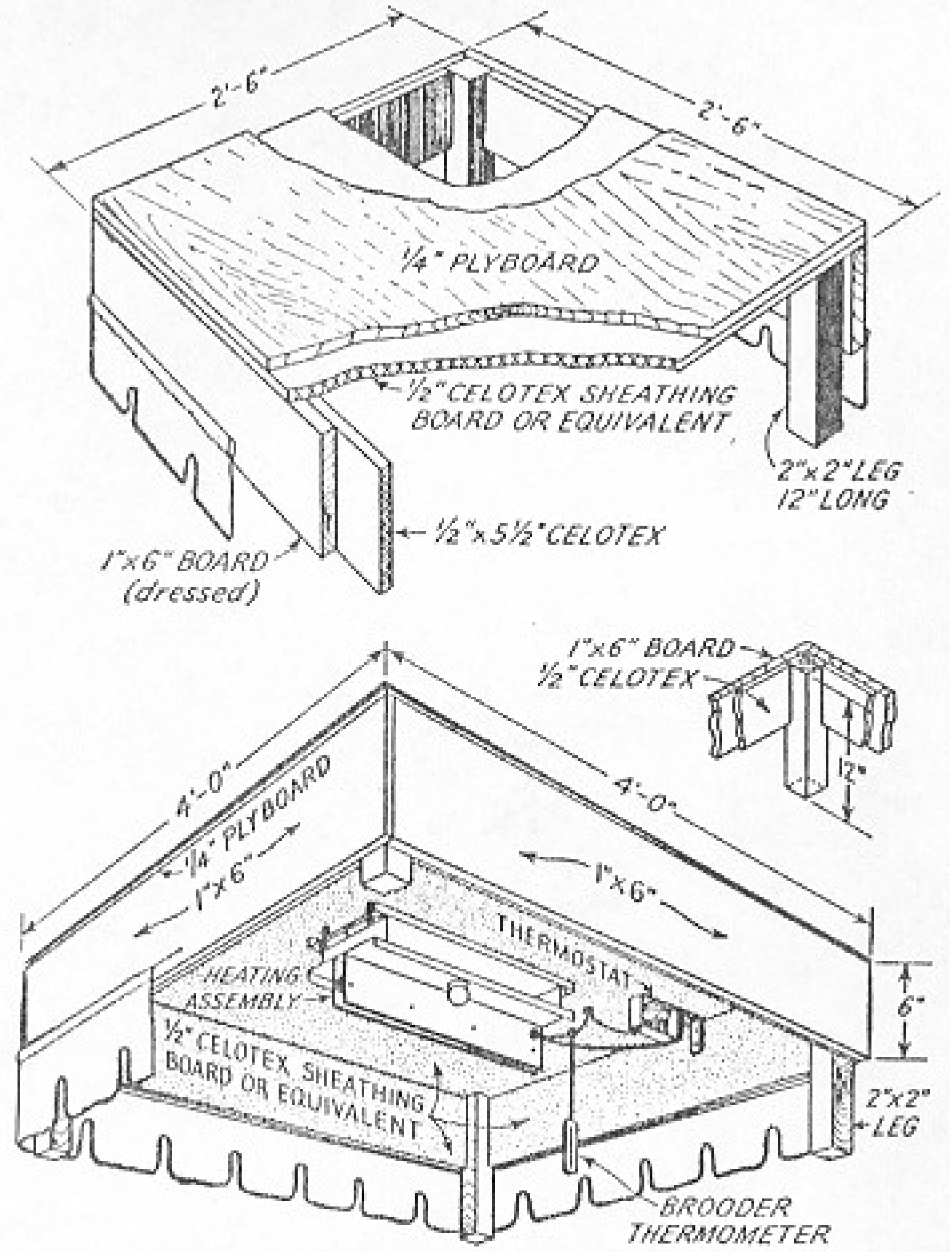
To protect the insulation, the inside of the brooder must be painted.

A saw, square, hammer, screw driver, brace and 1¼-in. bit are the only tools required to make this brooder. The homemade electric brooder offers the following advantages:

1. It has automatic heat regulation if used with a dependable temperature control.
2. Heat is under the hover only; chicks have access to cool air in the brooder room if desirable.
3. Even heat regulation lessens the possibility of overheating chicks.
4. It practically eliminates fire hazard.
5. It saves time and labor.
6. It is economical in operation.
7. It is easy to remove from the floor.
8. All floor space is available for chicks.

The electrically heated hover brooder costs about $8.50 for the 100-chick size, and $12 for the 200-chick size. These costs include all materials and the complete heating assembly.

Electric brooders of any desired size may be bought commercially. The cost will be about 100 per cent more than the purchase price of the materials. A 100-chick brooder may be bought for about $15 or $20.

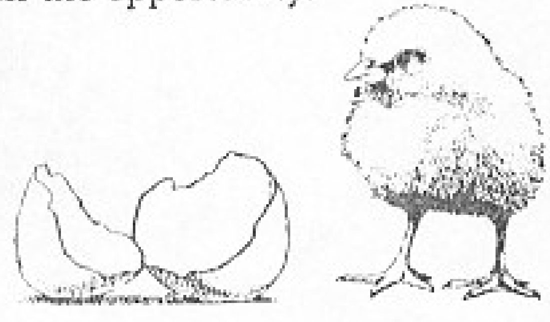


HOME-MADE ELECTRIC BROODER

Homemade electric brooder. Above, looking down on the 100-chick-capacity brooder; below, looking under the 200-chick-capacity brooder.

Practically every agricultural college in the United States has been experimenting with electric brooders during recent years, or since the development of the REA, and all have some design or type that is recommended. A request will bring anyone interested plans and specifications as well as suggestions for operation and use.

Baby chicks should never be kept too hot; this is the surest way to bring sickness and death. The hover-type brooder has the advantage of allowing the chick to get just as close or just as far away from the heating unit as desired; and the little biddies soon learn how to live comfortably, if given the opportunity.



BILL OF MATERIAL

Item	Quantity	Description
		100 Chick Capacity—Size 30″ × 30″
1	1 piece	¼″ × 30″ × 30″ Plyboard
2	1 piece	½″ × 30″ × 30″ Celotex or equivalent
3	10 lin. ft.	½″ × 5½″ Celotex or equivalent
4	10 lin. ft.	1″ × 6″ Board (dressed)
5	4 lin. ft.	2″ × 2″ Board (dressed)
6		Assorted box nails and roofing nails
7	8	⅛″ × 2″ round head stove bolts and nuts
8	8	⅛″ Flat Washers
9	1	Heating Assembly (Minimum of 225W-115V)
10	1	Brooder Thermometer
11	11 lin. ft.	6″ Brooder Curtain
		200 Chick Capacity—Size 48″ × 48″
1	1 piece	¼″ × 48″ × 48″ Plyboard
2	1 piece	½″ × 48″ × 48″ Celotex or equivalent
3	16 lin. ft.	½″ × 5½″ Celotex or equivalent
4	16 lin. ft.	1″ × 6″ Board (dressed)
5	4 lin. ft.	2″ × 2″ Board (dressed)
6		Assorted box nails and roofing nails
7	8	⅛″ × 2″ round head stove bolts and nuts
8	8	⅛″ Flat Washers
9	1	Heating Assembly (Minimum of 450W-115V)
10	1	Brooder Thermometer
11	17 lin. ft.	6″ Brooder Curtain

Items 1 through 8 can be secured from local lumber company.
Items 9, 10 and 11 must be ordered. Consult your County or Home Demonstration Agent or your local power Manager for names of manufacturers and prices of this equipment.

Materials needed for brooder illustrated on the opposite page. (*TVA.*)

The Brooder House

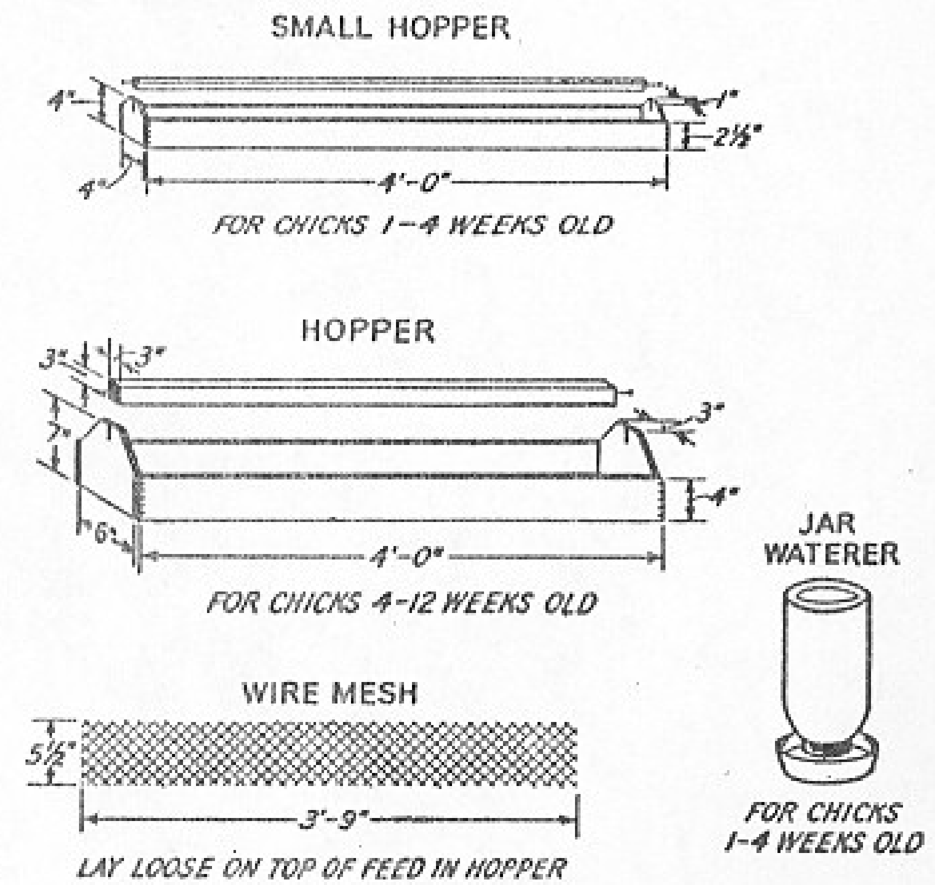
Commercial broiler producers use the individual brooder house. The house may be of any size. A house 14 by 16 ft. in size will accommodate from 300 to 500 chicks. Some poultrymen use larger houses and produce a greater number of chicks in one lot. Heat is supplied in a variety of ways, and the chicks live under and around a large cone-shaped metal hover. Few back-yard poultrymen will wish to engage in poultry production upon so extensive a scale.

Other Equipment

Other than a brooder, the producer of fryers needs little or no equipment. It will be necessary to have a *feed hopper* and a *water fountain*. These must be purchased at the hatchery or at a feed store. Types of both have been standardized; they vary only in size. You may depend upon your local dealer to recommend the sizes required. Feed hoppers may be made at home. Of course, pans may be used for feed and water, but they are unsatisfactory for the reason that the chicks climb into them and get both feed and water dirty. Also, the chicks should not be allowed to get wet and chilled.

Kind and Cost of Feed

The feed for baby chicks must be bought ready mixed. The proper feed is generally called a *starting mash*, or a *broiler mash*. It is available in bags of all sizes. *It generally takes about 6½ to 7 lb. of mash to grow a 2-lb. fryer in 9 or 10 weeks.* From this basis a calculation may be made in regard to the total quantity of feed required. The starting mash contains all the nutrients required for growth and



Essential equipment for raising broilers.

development. It contains many ingredients including cod-liver oil, dry skim milk, alfalfa leaf meal, and finely ground grains. It includes all the minerals and vitamins and protein essential for a well-balanced ration.

Feed should be kept before the chicks in the hopper at all times. The more they eat, the faster they grow.

Chicks will weigh 1½ lb. when 7 or 8 weeks old. At this weight they are ready for the frying pan. When 12 weeks old they should all weigh 2½ lb. apiece. Thus, for a period of 4 or more weeks the chickens may be killed and eaten as desired. *Then, when the supply is exhausted, the whole process may be started over again.*

If one starts with 60 day-old chicks in the lamp-type brooder, and 7 lb. of feed are consumed by each chick, 420 lb. of feed will be required. At $3.50 per hundredweight the cost of this feed will be about $14. This gives the basis for calculating the possible profit and loss in the undertaking of producing frying chickens in the back yard.

Is growing frying chickens profitable? If one spends $7.20 for baby chicks, $14 for feed, $5 for materials with which to build a brooder, and 75 cents for 5 gal. of kerosene, the total sum expended in a 60-chick project amounts to $26.95. From this investment, with good luck,

one may expect to get about 100 pounds of live fryers. This would mean that they were produced at a cost of 26 cents a pound, which is less than the price charged in most retail establishments at any season of the year.

Of course, one could not properly charge the entire cost of the brooder to one lot of chicks. This is permanent equipment; it may be used over and over again. Also, the project is not approached solely from the standpoint of financial gain. It is a food-producing enterprise, and, as such, it is a patriotic activity that will aid in the prosecution of the war. And, after the conflict is over, it will assist America in helping to feed the starving millions in countries less fortunate than our own. The rationing of meat has indicated clearly that there is not enough for all. Home production has the added incentive of supplying the food nutrients required for a diet through which the American people may be made strong, and through which they will be aided in keeping well. Meat is the foundation for such a diet.

First Steps toward Establishing a Laying Flock

It was said in the beginning of this chapter that chickens are kept for eggs and meat, and that the two enterprises are not necessarily related. It is apparent that the production of broilers and fryers may be a one-purpose undertaking. On the other hand, it may be made the first step toward the establishment of a flock of laying hens. All that is necessary is to eat the males (cockerels) and keep the females (pullets). By following this procedure, the owner will soon be able to gather his own eggs.

GATHERING YOUR OWN EGGS

Because they are compact and rich in essential nutrients, eggs are demanded for wartime food. They contain vitamins A, B, D, and E—only C is lacking. There are few better sources of iron. Eggs contain phosphorus, calcium, sulphur, and sodium and potassium salts in organic combination. They supply protein and fat of high biological value. An egg is a balanced food; it is easily and completely digested. Eggs are nearly interchangeable with milk; they approach being the perfect food.

For good health one's diet should include an average of an egg a day; this means an annual consumption of 30 doz. per person. Strangely enough, one egg each day for every man, woman, and child—the minimum standard for a liberal diet—is the normal production in the United States.

The person with a broiler project, designed to provide a part of the family's meat supply, has already taken the first essential step toward producing eggs for home use. A few of the better and larger pullets—and thus far we have given no consideration to sex because it has been assumed that both male and female birds would be used as broilers and fryers—may be saved with a view of keeping them as egg producers.

None of the cockerels, or young roosters, need be saved. In the production of eggs for eating, they perform no useful function. In fact, infertile eggs resulting when only hens are retained in the laying pen keep longer and better than those produced in mixed flocks. Should one wish to set the eggs for hatching, however, the services of a rooster are required for viability.

How many pullets should one keep? The answer involves two considerations: the number of eggs needed, and the production records of the flock from which the chicks were hatched. Of the two, the egg requirements are the more important, for it is assumed that few chicks of a record-breaking lineage will find their way into backyard flocks. Such chicks will be sought and retained by commercial breeders.

While not a major consideration in determining the number of hens to keep for producing the family supply, it is interesting to note, in passing, that high production is an acquired characteristic. Birds in the native state lay only enough eggs to reproduce young. But by selection and breeding, egg-laying capacity may be increased. Barnyard hens, without a controlled family tree, will, with good care, lay only 50 or 75 eggs in a year. The application of science, however, over a number of generations will result in hens that, with proper management, may be expected to lay 300 eggs in 1 year. Many fanciers with small flocks find the development of high-producing strains a fascinating hobby.

For all practical purposes, one may assume that, in season, one-half the hens in the back-yard flock may be expected to lay an egg each day. If one needs six eggs daily, the flock should consist of a dozen hens. It is usually recommended that a flock of 30 hens be kept to supply the eggs for a family of five. And, to maintain such a flock for the greater portion of the year, it is necessary to start with a larger number in the fall. Perhaps 40 would be about the proper number, but this will depend upon how often the family would like to have chicken for dinner during the fall, winter, and early spring.

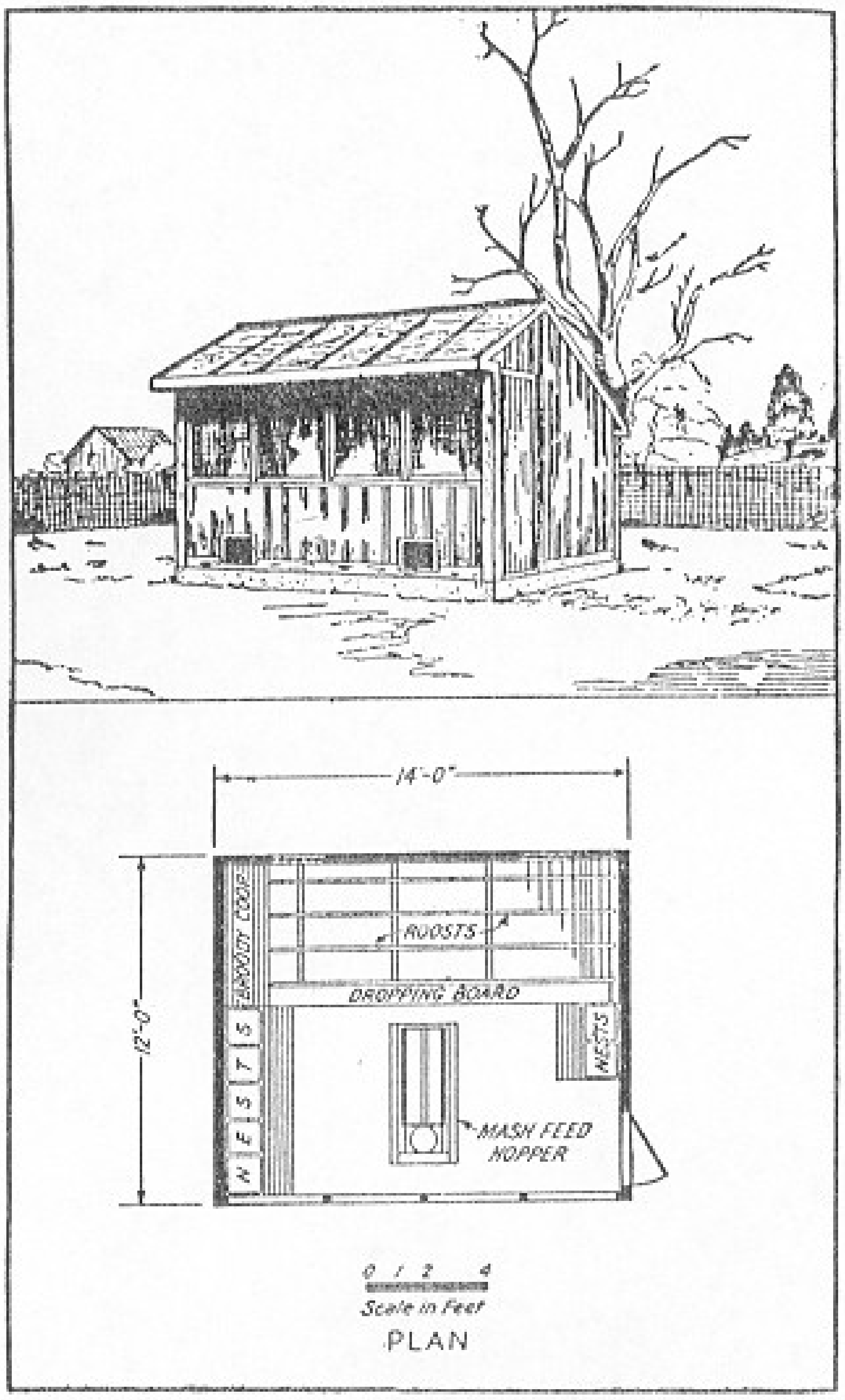
Laying Houses and Equipment

What sort of house must be provided for laying hens? And is a chicken yard necessary?

To answer the simpler of these two questions first, no yard is required. Back-yard flocks, and even commercial flocks, are raised in confinement. *They are never allowed outside the yard.*

Any house that is comfortable is satisfactory. The city

family that wishes to keep just a few hens does not need a large or an expensive laying house. A crude lean-to or appendage on the garage will serve the purpose. Perhaps there is a shed or a small building already available? Such a building can readily be converted into a satis-



Small back-yard laying house. Exterior elevation and floor arrangement. (*Georgia Extension Service.*)

factory poultry house. Only one important consideration need be kept in mind—*every hen should have 4 sq. ft. of floor space.* This means, for example, that 10 hens require a minimum of 40 sq. ft. of floor space. A house 5 by 8 ft. would meet this requirement.

If one wishes to build a laying house, then it may as well be large enough to accommodate a flock of say 40 or 50 birds. A laying house 12 by 14 ft. will be ample in size. It may be constructed of any material that is available, or built to harmonize with the home and surrounding buildings. With restrictions placed upon the sale of lumber and nails, it may be necessary to use other materials. This can be done; there is a large variety from which to choose. Hollow tile, for example, may be selected; concrete blocks are often used.

The house should be 14 ft. across the front and 12 ft. deep. It should have a door on one side, at the front. The roof may be of any style. A shed roof is the easiest to build; a gable roof—so that the roof may extend beyond the front wall and thus protect the birds from the weather if the front is left open near the top—seems to be more desirable. A good solid foundation of concrete, brick, or stone is needed. Drafts must be excluded or the chickens will suffer from colds.

The house should be about 7 ft. high, not that the chickens need so high a ceiling, but it is more convenient for the attendant. A concrete floor is desirable, but not necessary. With a hard-surfaced floor, the house may be kept clean with less trouble than is the case with a dirt floor. Of course, litter, such as straw, should be kept on the floor, and should be changed when sanitation dictates.

Nests should be provided—about 10 for a flock of 40 or 50 hens. The nests may be placed along the side walls. They should be about 2 or 3 ft. above the floor, to provide ample room below them for cleaning. They should be partially filled with straw and should be large enough so the hens will find them comfortable. In the very small house, in which one does not wish to go to much trouble, empty nail kegs, orange crates, or any type of box providing about the same amount of space will serve quite well. If they are placed too high off the floor for the hens to get into the nests easily, a ladder should be provided.

The roosts should be placed at the back of the house. Poles, 2 in. or more in diameter, will serve. Under the roosts there should be a dropping board. This is a solid floor, 8 to 12 in. below the roosts. Such a floor makes it possible, by using a hoe, to clean out the house easily. Also, of course, it protects the floor of the house, and is otherwise desirable.

A dry-mash hopper, which is simply a feed trough fastened to a platform, is an essential part of the equipment of a laying house. The hens must be able to eat mash at any time they like; the more they eat, the better. High-producing hens must be fed very generously. Any sort of platform and hopper will serve. It may be placed on the floor, but most poultrymen prefer that it be raised slightly above the floor, as this protects the feed and facilitates cleaning. The trough should be protected or partially covered so that droppings will not fall into the feed. If one is keeping only a few hens, it is desirable to buy a metal mash hopper of the kind that will be available and recommended at any feed store.

Your state college of agriculture will be glad to send you without cost plans and specifications for building a laying house suited to the locality in which you live. Desirable equipment will also be suggested.

Either inside the house or in the back yard, a broody coop should be provided. This is a coop in which to confine the hens that want to get about their natural task—the job of raising a brood of chicks. If a hen remains on the nest overnight and clucks as she is approached, then she is a candidate for confinement—*she is not laying eggs.* The sooner she is "broken up," the sooner she will begin to lay again. The broody coop may be a wire-enclosed frame of any size *with a slat bottom.* Such a floor makes it difficult for the hen to sit on the floor, and a "standing" hen soon gets over being broody.

Laying-house equipment should include a grit and-oystershell hopper, and a water pan. Hoppers for grit and oystershell may be bought at any feed store, but a small box about 4 in. high and not more than a few inches wide and about 1 ft. long will serve just as well. If boxes or homemade hoppers are used, they should be covered with a 2-in. mesh wire or with slats about 2 in. apart.

Water must be kept before chickens at all times. Any shallow pan will serve the purpose quite well, except that it will be easily turned over. This can be prevented by making a slatted cover that may be placed over the pan. Or a water fountain of any size desired may be purchased at any feed store, hatchery, or poultry supply center. Such fountains are more convenient and desirable than pans for the reason that the water is protected from contamination and a larger quantity may be provided at one time.

Flock Management

Now we come to some very important management questions! How old does a chicken have to be to lay eggs? And when are eggs most desired?

The heavy breeds recommended for home flocks must be 6 or 7 months old before coming into production, and eggs are usually highest in price during the fall and winter months. If a pullet begins laying eggs in the fall, she will continue to lay all winter, with good feed and care. This means that the egg production is most profitable and satisfactory when the pullets are old enough to begin laying in October. Consequently, the ideal time to secure the baby chicks for growing out laying pullets is January, February, or March. April chicks usually turn out well, however.

Naturally, it goes almost without saying that one must raise the layers for the home flock. The only alternative is that of buying pullets offered on the open market as broilers and fryers. Poultrymen cannot afford to sell laying hens. Those offered for sale have usually been culled from commercial flocks because they are nonproducers.

It is a simple matter to identify the laying hen. At one time these distinguishing characteristics were a profound secret and the knowledge was carefully guarded by those who possessed it. Later the secret was offered for sale at the price of $1, provided that the purchaser promised not to tell. Now the information is broadcast free of charge in government bulletins available on request from the Department of Agriculture, Washington, or your state agricultural college, and poultry specialists hold demonstrations so that all flock owners may know how to cull the nonlaying hen.

Culling nonlayers is not involved in the initial stages of establishing a flock. But it should be noted in this connection that hens attain their highest production during their first year of maturity. Old birds must be sold or eaten and younger ones added each year to maintain high and profitable egg production. Since every flock owner will wish to kill and eat the hens that do not lay eggs, the chart on page 45, showing characteristics of laying and nonlaying hens, supplied by the U. S. Department of Agriculture, will be of interest.

With experience, one will soon learn to distinguish between the laying and the nonlaying hen. But occasionally a hen will be killed that is a layer, and, on dressing her, one will discover a number of yolks and perhaps a fully developed egg in a shell.

Feeding the Flock

Feeding is the most important aspect of management. Each year a high-producing hen lays many times her weight in eggs. The raw materials for making these eggs must be supplied in the feed consumed. The egg is a self-contained balanced meal; the feed must be balanced also. The white of an egg is rich in protein; the feed must supply this protein. There must also be carbohydrates and fats for making the yolk, and there must be mineral for the shell. All these things must be found in the feed. If any are lacking, then egg production is reduced or stopped. The importance of supplying all the ingredients for a feed that will contain the nutrients for a hen's body and for the production of eggs cannot be emphasized too much.

Years ago, to a greater extent than at the present time, farmers allowed their chickens to wander over the place and each night and morning threw them a little shelled corn. This was not a bad practice, since the hens could forage for themselves. Like birds, they could pick up supplementary feeds in the form of seeds and insects. But corn is a very inadequate feed for chickens grown in confinement. It is a starchy, or carbohydrate, feed; it does not supply enough protein. Chickens fed in confinement must not only have protein, but they must have minerals and vitamins as well.

Hens must be given a *laying mash;* in addition, they

must have a coarse-grain feed. Laying mash can be bought at any feed store; in little sacks, holding only a few pounds, it is often sold in grocery stores. This feed is scientifically compounded. The makers of this feed guarantee the analysis that is given on the bag. It is inspected under the laws of the state in which it is sold. It must contain the analysis given on the bag. In fact, these feeds may contain a dozen ingredients. For example, to supply vitamin A such feeds contain alfalfa leaf meal that has been dehydrated. They may also contain such things as fish meal to supply minerals. Always they contain several cereal grains. They may contain meat or milk or cod-liver oil or any of a large number of ingredients that supply *all* the desired raw materials for the manufacturing of eggs.

SELECTION CHART

Characteristics Identifying Layers and Nonlayers

Character	Condition in a	
	Layer	Nonlayer
Comb	Large, bright red, smooth, glossy	Dull, dry, shriveled, scaly
Face	Bright red	Yellow tint
Vent	Enlarged, smooth, moist	Shrunken, puckered, dry
Pubic bones	Thin, pliable, spread apart	Blunt, rigid, close together
Abdomen	Expanded, soft, pliable	Contracted, hard, fleshy
Lateral processes	Prominent, pliable	Hard to find, stiff
Skin	Soft, loose	Thick, underlain with fat

Characteristics Indicating Whether Previous Production Was Continuous or Brief

Character	Condition associated with	
	Continuous laying	Brief laying
Vent	Bluish white	Yellow tint or flesh color
Eye ring and ear lobe	White	Tinted with yellow
Beak	White	Tinted with yellow
Shanks	White, rather flattened	Yellow, round
Plumage	Worn, soiled	Not much worn
Moulting	Late, rapid	Early, slow

Characteristics of a High-laying Strain

Time of maturity	Laying begins at about 6 months of age in the case of Leghorns and at about 7 months in the case of Rhode Island Reds, Plymouth Rocks, and similar breeds
Rate of production	Average of 180 or more eggs a year
Broodiness	Birds are seldom broody
Persistence of production	Hens are laying well in August and September toward the end of the first laying year or after it is completed

The laying mash should be kept before the hens at all times. It is placed in the hopper, which is a part of the laying-house equipment.

Hens kept in confinement must have grit and oystershells. Grit, which may be any hard stone, assists in grinding the feed; oystershells supply material for the making of eggshells. These are kept before the chickens at all times in small hoppers.

Laying mash must be supplemented with coarse grain. Any combination of several grains will be satisfactory. Grain feeds recommended for laying hens may be purchased in any quantity desired at local feed stores.

Grains should be fed in the evening. This feed sustains the chickens overnight. Metabolism takes place in fowls rapidly; that is why the birds that hop about your yard can eat all the time. They may eat hundreds of bugs and hundreds of seeds and worms each day. Mash consumed by chickens is digested within 3 hr. Without some grain in the crop, chickens would get cold and hungry during the night.

Since egg production depends, to a great extent, upon the quantity of feed consumed, and since chickens eat most of the time they are awake, it pays to give them a long working day. For this reason commercial poultrymen put electric lights in their poultry houses. These lights are turned on during winter afternoons and also in the morning several hours before daylight. As soon as the lights go on in the morning, the chickens get up and begin eating. They continue at the task of eating all day long and go to bed when the lights are turned off at night.

These lights are operated by an electrical switch connected with an alarm clock. Any electrician can install such a switch in your laying house if you wish to increase the length of the working day for the birds in your flock.

Vaccination

Proper sanitation, good feed, and comfortable quarters will, for the most part, ensure the health of your flock. One other thing must be added, however. Your birds must be vaccinated for chicken pox. The vaccine and the simple equipment for applying it may be bought at any feed or poultry supply store. The directions for using it are easy to follow. This job should be done one month before you expect your pullets to come into egg production.

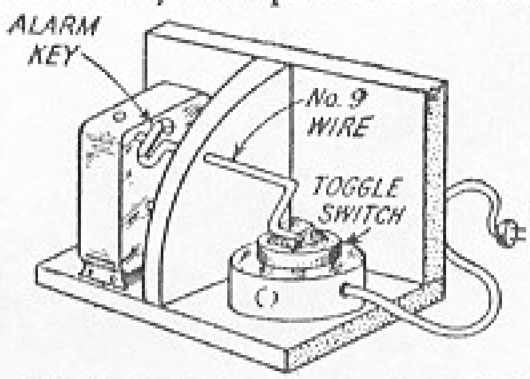
Possible Returns

Now let us glance at the financial outlook for the backyard egg-production enterprise! A well-fed hen, in one year, will eat from 80 to 100 lb. of feed—half mash, half grain. At present prices, mash costs $3.60 per bag of 100 lb. Mixed grain—cracked corn and wheat—costs $2.45 per bag of 100 lb. This means that, at these prices, the feed for each hen—assuming that she eats 100 lb.—will cost about $3 a year.

Based upon the average for thousands of flocks, each

hen should lay 170 eggs each year, or about 14 doz. These eggs, at the average price for 1942, are worth, conservatively, 35 cents a doz., or \$4.90 for the year. On the basis of these figures, a net profit of \$1.90 per hen would be realized, when only feed costs are considered.

Of course, there will be some other costs, such as grit, oystershells, vaccine—these are small. Costs for housing and equipment are higher, but these should not be charged against one year's production. Here again we should say that profit is not the motive in conducting the enterprise; it is, rather, an abundant supply of fresh eggs for home use. Incidentally, it is a roast hen for Sunday dinner any time you feel that you can afford (from the viewpoint of sentiment, primarily) to reduce the number of hens in your flock.



Alarm-clock switch. A simple homemade alarm-clock switch will turn the lights on and put the hens to work before daybreak. You can turn the lights off when you get up.

Storing Eggs for Winter

Peak egg production is attained by most poultrymen during the spring and early summer. During these months egg prices are normally lower than at any other periods of the year; then, while prices are relatively low and supplies large, commercial egg dealers place large quantities in cold storage for sale during the winter months.

Persons keeping back-yard flocks may find that during the season of most favorable production a surplus of eggs may accumulate. Then they, too, may store for winter. If space in a cold-storage plant is available, the owner of a home flock may store in the same way as commercial dealers. But since such facilities are limited, the water-glass and limewater methods are recommended.

Water glass, which may be bought in any drugstore, is most frequently used for the storage of eggs at home. This is a chemical substance composed of sodium silicate. For the storage of 15 doz. eggs, one should have a 6-gal. earthenware crock or jar and 1 qt. of water glass; 9 qt. of soft, boiled water also are required. The water should be boiled and then cooled before use. After the 1 qt. of water glass and the 9 qt. of water are mixed and put into the jar, the eggs may be placed in the container. Only fresh, perfect eggs—with no cracks in the shells—should be stored. A few may be put into the jar each day. The eggs should at all times be covered with at least 2 in. of the solution; that is, the top layer of eggs should not come within 2 in. of the surface. The jar should be kept in a cool place and should be covered with a piece of heavy brown paper.

Limewater may be used in place of water glass in storing eggs for home use. For the storage of 15 doz. eggs, using the limewater method, one should have a 6-gal. jar with the same kind of heavy brown paper previously suggested as a cover for the container; 2½ lb. of unslaked lime and 3 gal. of boiled water are required. The water should be boiled and cooled. The lime should then be put into the water. After it has stood for 10 min., the liquid should be put into the jar—care being taken to make sure that the lime sediment is not poured into the container, as only the more or less clear solution should be used. The jar should be kept in a cool place. From time to time, as they are available, the eggs may be put into the jar for storage.

Eggs may be kept in storage for a period of 6 months; but remember, *only strictly fresh, infertile eggs may be stored.* Place them in the container *carefully* so that the shells will not be cracked.

PERHAPS YOU CAN KEEP A PIG?

VICTORY BARNYARD, 1943
Paul W. Chapman

Home Consumption and War Needs

"We need all the pork and pork products we can get," said a representative of the British government recently. The same thing may be said for the United States. In spite of increased production on American farms, it was often impossible, before rationing was instituted, to buy lard and bacon in many retail stores.

Pork is a satisfying food. Among the meats it is the best source of vitamin B_1. The fats that hogs supply are concentrated energy. When fats are taken out of the diet, a physical breakdown follows; evidence of this fact is found in the condition of the people in continental Europe today. We are struggling to avert such a condition at home. To supplement inadequate supplies of lard, American farmers have been called upon to increase greatly the production of oil-bearing crops, mainly peanuts and soybeans.

America's Pig Keepers

Hogs are grown on farms in all sections of the United States. Production is concentrated mainly in three areas —the Middle West, where they are fed corn; the South, where they help harvest the peanut crop; and the dairy sections of the East, where they consume a ration includ-

ing skim milk and buttermilk. Only chickens have a wider distribution. Several hundred thousand boys and girls are members of 4-H pig clubs. Millions of families in small towns keep a pig in the back yard.

As meat animals, pigs have many things in their favor. They multiply rapidly. When properly fed, they attain a weight of 200 lb. at the age of 6 months. They make more rapid gains, for the feed consumed, than any other meat-producing animals.

There is little sentimentality attached to the hog business. One may become attached to a dog, a pony, a sheep, a dairy cow—but rarely to a pig. We tend to despise swine. Few, indeed, are the persons who have raised their voices in behalf of the lowly animal that furnishes more of our meat supply than any other. The following tribute, however, did appear in one of our farm papers in 1898.

It is well, when we contemplate the splendor of our achievements, to give due credit to that most despised of all farm animals—*The Hog.*

Before the age of railroads, the hog solved the transportation problem by turning himself into a package that could walk to market with what represented 10 to 20 bu. of corn. He furnished a market for grain and grass. He enables the wasteful steer to be fattened at a profit. Where farmers have held to one crop, the second crop has invariably been a mortgage—but the hog that makes more meat with less feed than any other animal has been a mortgage-lifter.

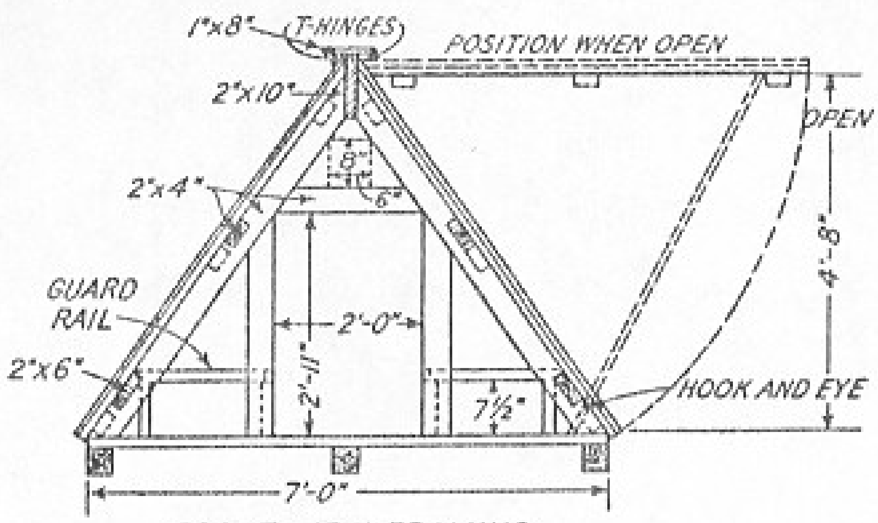
Wherever the hog has gone to market in large numbers, deposits swelled in banks, customers filled stores, and wealth increased.

The hog has fed a hungry world. And the toothsome ham—tender and sweet—is pleasing to the palate of rich and poor alike.

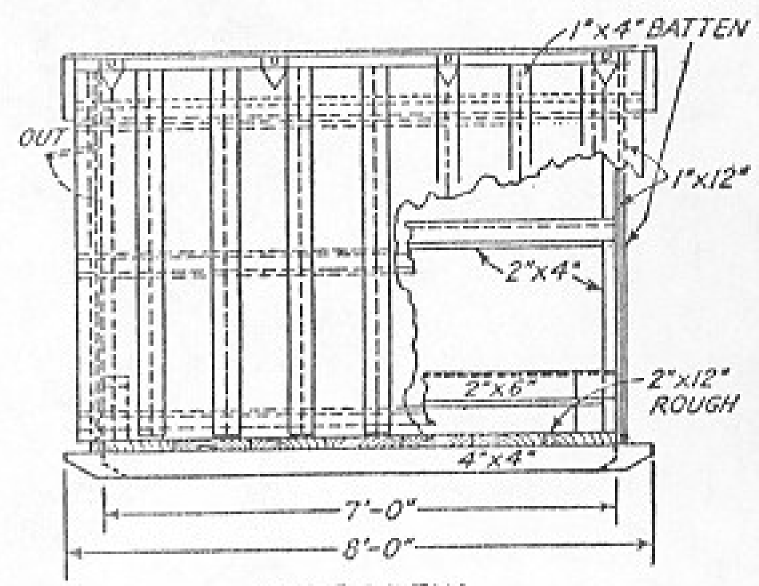
We salute the hog—our benefactor!

Swine production is not only an important commercial enterprise on American farms, but it is the chief source of meat supply for home use. Farm families eat little beef; they have had no way, other than canning, to preserve and store the meat. Now, freezer lockers are supplying a satisfactory method of storing; they are putting beef into the diet of America's rural people. On the other hand, pork lends itself to curing and smoking, so that it may be processed and stored without refrigeration. Millions of hogs are slaughtered on farms each year.

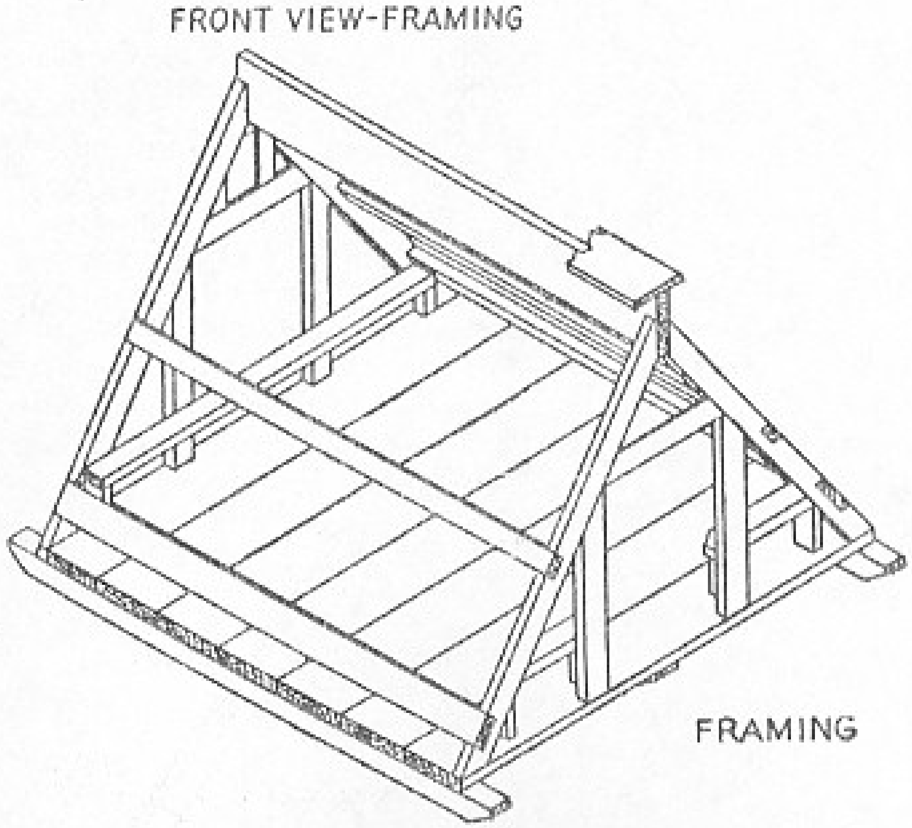
The annual food budget for a farm family of five calls for providing 450 lb. of pork—as contrasted with 200 lb. of beef. To supply this quantity of pork, three 200-lb. hogs are required. These hogs are usually butchered one at a time in order that the maximum amount of fresh pork may be available.



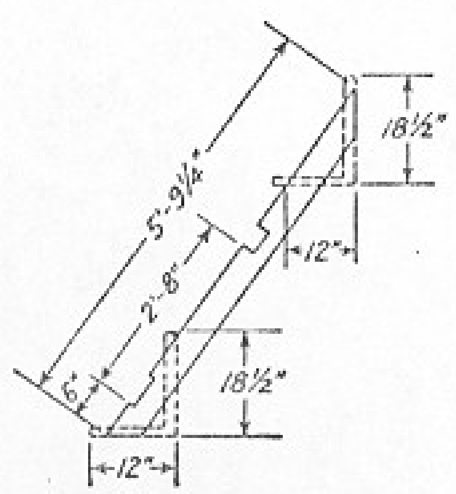
FRONT VIEW-FRAMING



SIDE VIEW



FRAMING



RAFTER DETAIL

A portable hog house. The back-yard porker does not require a house, which seems to have

but, if one is provided, it may conform to the standard A-shape design, been universally adopted.

One hog, weighing 225 lb., will supply the following

products for home use:

Products	Pounds	Products	Pounds
Lard	32	Ham	30
Picnic ham	15	Shoulder roasts	11
Pork loin	25	Cured bacon	17
Spareribs	4	Neck meat	2
Sausage	9	Pig's feet	2

When live hogs are worth 15 cents a pound on the market, a 225-lb. pig will sell for $33.75. But the meat products listed above will cost not less than $46.62 when purchased in retail stores. This difference enables anyone who butchers a pig at home to save $12.87; or, stating the same thing in another way, one is earning this sum for the time spent in butchering a hog and curing and processing the meat and lard. The sum might be spoken of as the meat packers' compensation.

In addition, the back-yard pig keeper also earns the compensation normally going to the feeder. How much this will be depends upon many factors, including the price paid for the pig and the quantity of commercial feed bought to fatten the animal.

Feeder pigs—that is, lightweight pigs for fattening which weigh from 75 to 100 lb.—during emergency periods sell for a premium on the market. They may be from 3 to 5 cents above the market price for fat hogs. This means that one may be compelled to pay 18 or 20 cents a pound for a back-yard pig, or from $13 to $20.

Emergency Pig Feeding

High prices and scarcity prompt a consideration of pig feeding as an emergency activity on the part of town and suburban families. Is it possible? Is it desirable? How may it be managed? These are the more important questions involved.

Most cities have ordinances prohibiting the keeping of domestic animals—other than dogs and cats—within the city limits. In a national emergency enforcement will be lax. No objection will be raised to keeping chickens, rabbits, or pigeons. But the hog will be, generally speaking, taboo. Restrictions, however, will not apply to most small towns. They will not apply to persons with considerable acreage, and to estates. Many families may produce their own pork, if they like. What are the steps and problems involved for those who wish to engage in emergency pig feeding?

First, there must be a pen. Assuming that there will be but one pig (or two), the pen may be small. It need have no floor; simply an enclosure, with some protection from severe weather to which the occupant may retire, is sufficient.

Second, one must buy a pig. If possible, the purchase should be made from a near-by farmer, and the porker brought home in the car—mileage rationing permitting. Information as to source may be obtained from your county agent, who has an office at your courthouse or post office. If it is not convenient to get a pig from a local farmer, purchases may be made at your local packing house or abattoir. A few small, lightweight pigs always find their way to market too soon. Usually these are sold for feeding purposes.

What age and kind should be bought? Pigs get their start in life from mother's milk. After that they *should* have the following experiences: At 2 weeks of age they are taught to eat a little supplementary feed in the form of mash; at 4 weeks the male pigs should be castrated; at 6 weeks, vaccinated against cholera; at 8 weeks, weaned; at 10 weeks, wormed for the elimination of internal parasites.

All these things should have happened to the pig before it is purchased by the back-yard pig keeper. They are important. Cholera is the most serious disease affecting swine. It can be prevented by the simple process of vaccination—just as human beings are protected from smallpox by vaccination. Male pigs must be castrated while young. If this is not done, the meat may be strong. Internal parasites constitute a serious pest in most sections of the country; the process of worming, which is practiced by the best hog producers, will usually stop the trouble once and for all, especially if the hogs are fed on ground that has not been contaminated.

If pigs are purchased from farmers, inquiries may be made about all these things. If they are purchased from a packers' supply yard, or any similar place, inquiries about the pigs' early experiences are not possible. But appearance will tell the story. Thrifty, healthy pigs are active and vigorous and well filled out. Beware of the thin pig with a straight tail and ribs that are too plainly visible. Such a pig will not fatten rapidly.

As to breed, this makes no difference, unless you have a preference as to color and minor characteristics. For anyone who is concerned the table of breed characteristics may be of interest.

Breed	*Appearance*
Poland China	Black, floppy ears, white feet and tail
Duroc Jersey	Red
Chester White	White
Hampshire	Black with white band
Berkshire	Black, pointed ears that stand up
Spotted Poland	Mottled—black and white

These concise notes will enable one to become better acquainted with his pig. But it does not make a particle of difference whether the pig conforms to any of the

markings or characteristics listed. Many farmers prefer what are called *crossbred* hogs. These are hogs produced by crossing one breed with another—perhaps a Duroc sow and a Poland China male. The result will be a litter of red pigs with black spots. Some feeders think that such crosses make for stronger pigs that fatten faster than those purebred.

Breed is very important in cows for the reason that it determines the quality of the milk. It is also important in chickens, where it determines weight and conformation. It is important in many other animals, but pigs are all produced for meat, and there is actually little difference in the meat so far as breed and age are concerned.

The quality of meat in hogs is affected by feed more than by breed, age, or other considerations. Peanuts and soybeans, for example, produce a soft oily meat, which has a good flavor, but which, among other things, shrinks in the frying pan to a fraction of its original size. Corn produces hard pork. Garbage tends to produce a soft, watery pork. It is recommended that garbage-fed hogs be finished on corn or some commercially mixed feed like *hog chow;* that is, during the 2 or 3 weeks prior to butchering, the garbage that is fed should be reduced in quantity or eliminated entirely, and grain or mixed feed substituted.

Feeding the Back-yard Pigs

It is assumed that back-yard pigs will be fed on table scraps and other waste food products. This feed may be placed in a tight box or trough. It may be fed exactly as it comes from the kitchen or it may be mixed with additional water and some commercial feed available at any feed store. The addition of this commercially mixed feed is desirable, even if but a small quantity is used. Such feed contains protein and minerals, both of which may be lacking in the garbage feed. Every manufacturer of hog feed publishes a booklet giving directions for its use. These directions may be followed, except that the quantities recommended may be reduced if much garbage is available.

Pigs in the back yard should be fed morning and night. They may be watered at the same time. A metal trough, which is easy to wash, is recommended as a water container. It is interesting to know how swine producers feed pigs.

First, pigs on pasture gain faster than pigs in a pen.

Second, pigs gain most rapidly when fed a balanced ration; this means that carbohydrates and proteins must be supplied in the relative quantities needed. To accomplish this balance, most pigs are fed corn and tankage, which is a packing-house by-product composed mainly of meat scraps.

Third, pigs will balance their own meals if given the chance. Many farmers use self-feeders. These are boxes or bins placed in the pasture or feed lot. They contain two or more compartments—each with a different kind of feed. The pigs help themselves whenever they are hungry. They take some of each feed—just enough of each to supply the needed nutrients in the proper proportion. Most animals will eat too much if given the chance, but not pigs; they are too smart.

In the back yard, one will know how much feed to use as a supplement to garbage. Give the pig all he will eat each day. He will know when he has enough. The more he eats, the faster he will grow. In proportion to weight, little pigs eat more than big ones, but big ones put on weight faster. After pigs attain a weight of 100 lb., they will gain 1 lb. each day.

Pork on the Table

It is assumed that back-yard pig keepers are producing pork for home use. This means that the hogs are to be butchered.

Butchering is done, usually, in the fall. In many sections the first cold spell is known as *hog-killing time*. It makes no difference how much the hog weighs—perhaps 175 lb., possibly 350. It is assumed that pigs will attain a weight of 200 lb. at 6 months of age; these are the approximate goals of commercial producers.

Farm families, and those with previous experience, butcher and cure their own meat; they make sausage and lard. Information concerning these jobs can be secured in detail easily. The Morton Salt Company (Chicago) sells for 50 cents a booklet entitled "Meat Curing Made Easy." At the same price Montgomery Ward & Co., Inc. (Baltimore) will supply "Butchering on the Farm." Without any cost, one may obtain from the U. S. Department of Agriculture, in Washington, a bulletin "Butchering Pork," known as *Farmers' Bulletin* 1186. Many other related publications may be obtained from the same department, including "Pork in Preferred Ways" (*Leaflet* 45), "Cooking Cured Pork" (*Leaflet* 81), "Fats and Oils for Cooking" (*Leaflet* 204).

Of course, it is not necessary for back-yard pig keepers to do their own butchering. In many communities there are meat-curing plants that butcher, cure, and store the meat for a small charge. In every town and city there is an abattoir that prepares meat for local markets. Most of these establishments will do part or all of the job.

There are no restrictions imposed by Federal agencies upon butchering any animal for home use. But if you wish to sell a part of the product, either at the time of butchering or later, a permit to do so must be secured from your county agricultural war board. This local authority may be contacted through your county agricultural agent.

Growing out one pig may not seem to be a very substantial contribution to the nation's food supply. But it will supply a goodly portion of meat required by one family. And consider what the pig keepers' clubs have meant to England! They could mean as much to America.

A DAIRY GOAT FOR EVERY FAMILY

The title of this chapter is the Victory slogan proposed at a convention of the American Goat Society held in New York in 1942. Members of this society, those belonging to the American Milk Goat Record Association, and persons identified with other organizations devoted to the improvement of this animal, see the goat as the ideal source of milk supply for every American family, rural and urban. To many people in the United States, millions of whom have never seen a milk goat, this is a new and novel idea; but based upon the experiences of those in our own country who already keep goats, and upon a world-wide viewpoint, the slogan is practical and logical.

Goats are found in all parts of the world, other than the Polar regions. With the exception of the dog, no other domestic animal is so widely distributed as the goat. Such popularity is evidence that the people of the world have found goats to be practical and useful animals.

Milk from goats is said to be superior to cow's milk in two respects. *First*, it is digested more quickly and more completely. *Second*, it is a safer product to consume as *raw* milk.

The fat particles in goat's milk are much smaller than those in cow's milk and, therefore, more easily digested. The curd of cow's milk forms a dense, adhering mass, slowly soluble as compared with that of goat's milk. The curd in goat's milk is light, flaky, friable, and easily soluble. Many doctors have endorsed and recommended the use of goat's milk. One of them, typical of all, said:

> The chemical composition and ease with which goat milk can be digested by depleted individuals make it a most desirable food.
>
> No food will give as much return in assimilable alkaline, minerals, balanced proteins, carbohydrates, fats, and vitamins, with so little taxation on digestion as goat milk. The weakest of the weak prove capable of digesting and assimilating its wonderful building substances. Enervation is more quickly overcome by its use than by any other method known. Its blood-building, nerve-restoring qualities for young and old is not questioned.

Goat's milk is not a medicine, but it is recommended for babies and persons who are ill. It is reported that babies who will not gain on cow's milk often show marked improvement when put on goat's milk. Many hospitals serve goat's milk exclusively to patients. The milk is very palatable. It differs from cow's milk in that the "cream" does not rise to the top so readily; this is due mainly to the small size of the globules of which the butterfat is composed. The cream may be separated from the milk, however, and a very delicious butter can be made from goat's milk. It may also be used in making cheese and other dairy products.

Goat's milk may be consumed *raw* with safety. This is a very important point in its favor.

Milk is said to be the perfect food, and so it is. But the U. S. Public Health Service insists upon having it pasteurized. This is necessary, it is contended, to safeguard public health. Of course, this service has no control over what is done—authority is vested in city officials—but it has recommended the *model* milk ordinance so successfully that in most towns and cities no raw, or unpasteurized, milk is offered for sale. Pasteurization, of course, is a process in which milk is heated to a temperature high enough to kill bacteria, which is a very high temperature. While the process may be carried on in a scientific manner so that the nutrients are preserved, there is no guarantee that the milk may not be "cooked" to death, so far as nutrients are concerned.

Milk is pasteurized mainly to overcome the possibilities of transmitting cow-borne diseases. Chief among these are tuberculosis and Bang's disease, which in human beings may produce undulant fever, sometimes called brucellosis. For years our Federal government has been waging an aggressive campaign to wipe out these diseases. Remarkable progress has been made.

In my opinion, clean, raw, cow's milk is perfectly safe to drink, if it comes from disease-free cows. All commercial herds must be tested from time to time in accordance with state laws. Any veterinarian can test one's family cow; it may be advisable to have this done, especially when a new animal is purchased. But it is significant that goats do not have tuberculosis. They do not have Bang's disease. Goats are as nearly disease-free as any domestic animal. *It is not necessary to pasteurize goat's milk.*

It is impossible to state how many milk goats we have in the United States. The census gives the number of milk goats on farms "of three acres or more" in size. Perhaps this includes all commercial goat dairies and a number of goats kept for providing the home milk supply. But half the milk goats in the United States are found in the back yards of homes in industrial communities and metropolitan areas. Such goats were not counted by the census takers.

Milk goats are found in every part of the United States. There is not a state in the nation that has not a number of herds. Some states have several goat societies and

associations; all have breeders of registered stock. According to the census for 1940, the mountain and Pacific regions have the largest number. In California, particularly the Los Angeles district, the milk goat has become very popular. The North Central States, both east and west, have large goat populations. New York State has so many milk goats that six active associations dealing with the industry are maintained.

America's leading goat-feed manufacturer reports that the goat population is increasing very rapidly and that the greatest development is taking place around industrial areas, including such cities as Pittsburgh, Baltimore, Philadelphia, and Birmingham. Wartime scarcity of milk and dairy products is largely responsible for the growing interest in goats. A similar development occurred during and following the First World War.

Milk Goats for City Consumers

What are the advantages that the goat offers as a source of home milk supply for residents of towns and cities? This question is answered in the 1937 Yearbook of the U. S. Department of Agriculture in the following words:

> A goat can be kept where it is impossible to keep a cow, and a good producer will supply sufficient milk for the average family. The milk is a wholesome and nutritious food, and, in addition, the meat is palatable and nutritious. In localities where an adequate supply of milk is not available and the keeping of a cow is impractical, good milk goats will contribute materially to the welfare of many families.

Cornell University endorses the milk goat in the following statement made in "The Dairy Goat" (*Bulletin* 414):

> Many families on the outskirts of cities, in small towns, or on small holdings throughout the State can with advantage keep two or more goats to supply themselves and their neighbors with fresh, wholesome milk and butter and cheese. Besides the family use of goat's milk, any surplus milk may be used profitably in the raising of dogs and other animals that have a fairly good pedigree value. The goat is a friendly animal, is easily kept, and with proper attention is exceptionally healthy and relatively free from many of the troubles that affect other domestic animals.

The American Milk Goat Record Association distributes a booklet in which Dandridge P. West, Norfolk, Va., is quoted as saying:

> The crowded and intensive conditions of agriculture, and the further consequence of soaring prices for dairy products, have created a demand for an animal that produces milk more economically than the cow and under conditions where a cow could not be kept. This demand the well-bred goat fulfills.

Grafton Lothrop, manager of the dairy department of the Ralston Purina Company, St. Louis, says:

> An original investment for a good milk goat giving from 3 to 4 quarts per day is less than $50. This animal can be kept in the back yard where a cow could not be. It can be fed for less than $6 a month. This means a very low cost per quart of milk. The matter of labor does not enter into the maintenance of a goat because it becomes a pet and is tended by some member of the family in spare time. This is a particularly strong factor in favor of the milk goat under present-day conditions.

Statements such as the four quoted are typical. They could be multiplied many times by personal and agency endorsements of the milk goat as an excellent source of the family's supply of dairy products.

When it is compared with the cow, the following advantages of the milk goat may be cited:

1. A milk-goat doe (or even two) costs less than a cow.
2. One cow eats as much as six or eight goats.
3. Goats do not require as much room as cows.
4. Less space is required for storing feed for goats.
5. More of the goat's feed may be supplied without cost, if one is willing to collect it. (Goats need nourishing feed but will eat trimmings from trees, weeds, and other things that cows would not touch.)
6. It is less trouble to arrange for the breeding of a doe than for that of a cow.
7. On the basis of investment and maintenance costs, goats may produce milk of greater value.

Goats, when compared with cows, naturally have some disadvantages. Among these we might mention that the goat gives much less milk than a good cow. It requires a longer period of time to milk a given quantity of goat's milk than the same quantity of cow's milk. Also, the goat has a longer dry period than the cow.

In answer to these disadvantages, it may be said that one well-bred goat will supply all the milk required by the average family. The total time involved in milking is small. If two goats are kept, a continuous supply of milk may be assured.

Types and Breeds

There are three types of goats: (1) the mohair, Angora; (2) the short-hair, American; and (3) the milk-group. Each type has been developed to supply a specific product—the first, long *hair*, called mohair; the second, *meat;* the third, *milk*. All types may be used for meat; the pelts or skins of all types are used for making shoes, gloves, pocketbooks, and other small articles. More than 50 million pounds of goat skins are imported annually; most of these skins come from Africa.

We are interested, at the moment, only in goats of the third type—those developed for the primary purpose of producing milk. Only goats of this type will serve as producers of the family's milk supply. There are many breeds of milk goats. We shall consider the characteristics

of the four most numerous in the United States. These are Toggenburg, Saanen, Nubian, and French Alpine.

Toggenburg.—Imported from Switzerland, these goats are generally hornless, brown in color with a white stripe down each side of the face. Very hardy, they can be kept in any climate, hot or cold.

Saanen.—Largest of the Swiss breeds, these are white and, as a rule, hornless. A production record is held by the breed of 4,161.7 lb. of milk and 183.5 lb. of butterfat in 9 months and 8 days. These animals are suited to all climates. Where space is limited, the animals make good records when stall fed.

Nubian.—Tall, with drooping ears, generally hornless, and varied in color, this breed was developed by the English people and represents crossbreeding with African goats. While they do not give so much milk as the breeds previously discussed, the milk of the Nubians is rich, and the breed is known as the Jersey of the goat family.

French Alpine.—Imported from France where the breed has been developed for production and size without regard to color and markings, this breed is large in size and quite hardy, and has a capacity for production.

Buying Dairy Goats

Before discussion of the problems involved in buying goats for providing the family milk supply, a common error should be corrected. It is believed by many that goats have a bad smell. This is not true, as far as the females (does) are concerned. Does are odorless; they are clean and appealing. It is the males (bucks) that give the goat family a bad name. Even they may be comparatively odorless if kept clean. However, since few persons interested simply in the family milk supply will keep any bucks, the problem does not confront the keeper of back-yard dairy goats.

Many questions concerning purchases will occur to the individual who for the first time launches a goat-keeping enterprise. We will attempt to answer the questions commonly asked, assuming that the buyer is interested in keeping goats only, or primarily, to provide a home supply of milk. The following 10 questions will cover the more important factors to be considered.

Q. *How should one start with milk goats?*

A. It is possible to start with one doe, but it is recommended that the purchaser consider buying two does. Two goats seem to thrive better than one. Also, since one goat will be *dry* a portion of the year, two goats will provide a continuous supply of milk.

"The Purina Goat Book" (published by Purina Mills, St. Louis, Mo.), which will be sent to anyone on request, contains the following paragraph:

No animal suffers more from homesickness than the dairy goat. A doe that is producing well may decrease greatly in production when she is moved. However, good care and feed, plus affectionate handling, will frequently overcome the adverse effects of moving. It is frequently advisable to buy two or more animals in establishing a flock so that lonesomeness and homesickness will be minimized.

Q. *Is age a matter of importance?*

A. No. Does between 2 and 5 years old are to be preferred, as they are in their high-production period. Of course, such does will cost more than those that are much younger or much older. Does produce well until they are 8 or 10 years of age. Kids may be purchased at a relatively low cost, but the purchaser will have to wait for his milk until they attain a production age.

Q. *At what stage of the lactation period should does be purchased?*

A. Most authorities recommend that a dry or nearly dry doe be selected. Such a doe, bred to freshen soon, will get adjusted to her new home before coming into production.

Q. *What breed shall I choose?*

A. This is a matter of personal opinion.

Q. *Should I buy grades or purebreds?*

A. This depends upon how much money you want to spend. Cornell University says by all means buy grades. There are two reasons for this point of view. *First*, there are not enough purebreds for all. *Second*, a beginner may just as well learn on less expensive animals.

Q. *How much must I pay per head?*

A. This is, also, a matter of personal opinion. Enough should be spent to buy *production*. A grade doe may be bought for $10 or $15. Does with good production records may cost $25 to $50. Purebred does may cost $100 or more. The record price, I believe, is $2,500.

Q. *Should a back-yard producer expect to sell breeding stock?*

A. Yes, after gaining some experience. But at first the advisable thing is to concentrate upon producing the family milk supply. The kids may be raised, sold, or slaughtered.

Q. *What characteristics should one seek?*

A. Healthy goats in good physical condition. Also, goats from a herd or flock milked each day. Choose a doe with a good production over an entire lactation period—not one that for a few days or a few weeks may have produced a large quantity of milk. Anything above 2 qt. a day is good production, if one is interested in milk for the family.

Q. *Should one expect any guarantees from the seller?*

A. This depends upon how much is paid, what the

seller promises to deliver, what stipulations, if any, are made in connection with the purchase.

The American Goat Society recommends the following 10 points as a guide for fair-trade rules. These may be the basis of a bill of sale signed by both seller and purchaser.

1. Both the seller and the purchaser know before the transfer that the goat is the (*a*) purebred registered; (*b*) grade recorded; or (*c*) grade with no record.

Any misrepresentation shall nullify the sale and entitle the purchaser to return of any monies paid.

2. The seller guarantees the fertility of a buck. If the buck proves infertile, then the seller shall make satisfactory exchange for another animal or refund the money paid. The purchaser shall pay the transportation charges on a second animal. If the goat sold is a doe, there is no guarantee of fertility.

3. If the goat is a bred doe, both seller and purchaser should distinctly understand whether the doe is "Guaranteed bred" or merely "Presumed to be bred." In case of "Guaranteed bred," the seller shall make satisfactory exchange for another animal or refund the purchase price if the doe is not bred. In case of "Presumed to be bred," the purchaser assumes the responsibility.

4. The full purchase price shall be paid before delivery of the goat with the proper registration papers, accompanied by the duly signed transfer papers. It is the duty of the seller to complete all necessary records or transfers conferring title to the buyer.

5. The purchaser shall assume transportation costs of animals purchased, including transportation costs of any animal returned to the seller.

6. The owner of a buck cannot guarantee that a doe will be with kid, but he shall provide, without further cost, a second mating if desired within 7 months of the first service.

7. The goat transferred or sold shall be in good health and conform to markings given on the certificate of registry.

8. Goat is horned; dehorned; disbudded; or hornless.

9. The purchaser must report to the seller any dissatisfaction with any animal within 10 days, except in case of infertility.

10. The A.G.S. is not responsible for private sales between individuals, but we expect A.G.S. members to follow fair-trade rules.

Q. *Where may one find goats of the kind desired?*

A. There are milk goats near you, regardless of where you live. Purchases should be made from the locality in which you reside. If there are goat dairies in your community, they will sell you goats, or tell you where they may be purchased. Your county agricultural agent will know of breeders in your community. The dairy department in your state agricultural college will be able to supply a list of breeders or a list of the organizations in your state devoted to the goat industry.

A buyers' service is maintained by the American Goat Society, Lincoln, Neb. On request, a list of the breeders in the state and region in which you live will be mailed. The same service will be rendered by *The Goat World*, Vincennes, Ind., official magazine for the American Milk Goat Record Association.

Equipment for Goat Keeping

It is assumed that the equipment of the back-yard goat keeper will be held to the minimum. This is desirable in the beginning. It may be unavoidable in wartime, as there are restrictions placed upon the building of anything not absolutely essential.

A building or shelter of some sort must be provided. This may be a small shed; it may be the garage, or a part of it. A lean-to attached to the garage may be built. Essentials of the shelter are that it be dry, well ventilated, constructed sufficiently well to keep out cold winds. Ideal conditions visualize a small shed of not more than 10 by 18 ft. and high enough to permit the attendant to walk around comfortably inside. The floor space may be arranged in any way desired, but it should provide tie stalls or box stalls, a milking room, and a feed-storage compartment.

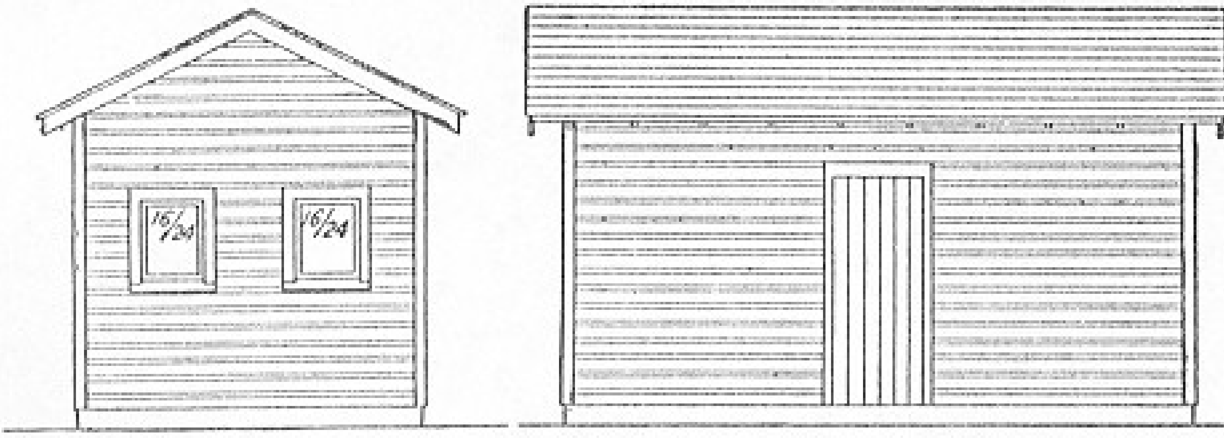
A separate feeding stall for each goat may be 2 ft. wide and 4½ ft. from front to back. Box stalls are preferred, as they give room for exercise if about 5 ft. square.

A shed of the size suggested will be large enough so that a little pen for kids may be provided, if one wishes to keep the young goats.

A very small milking room is desirable but not necessary, especially if one provides box stalls. The milking room should have a concrete floor, if possible, so that it may be kept clean easily. And a milking stand should be provided. This is a little stand on which the goat is placed for milking. The stand may be fastened to the wall or not, as one prefers.

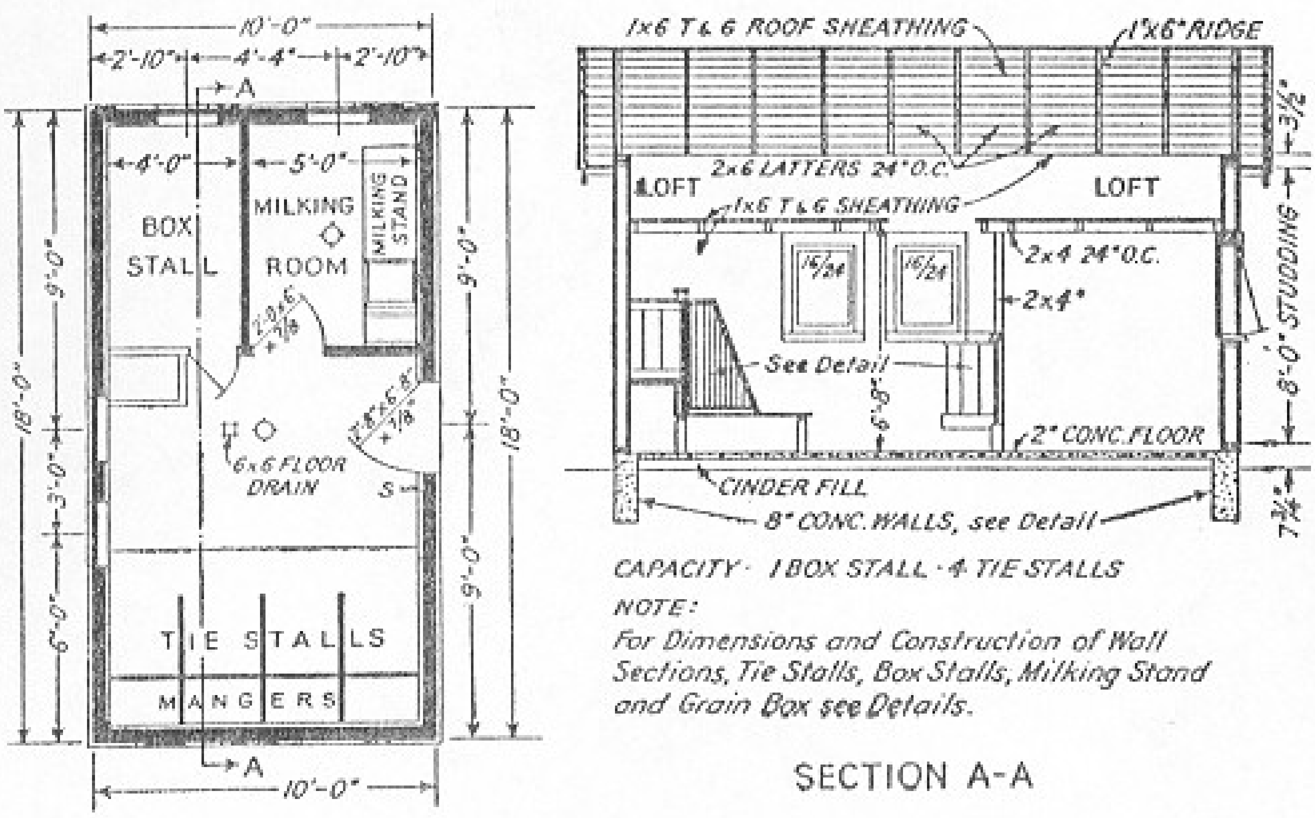
Concrete floors simplify cleaning, but they are cold and therefore not desirable. If the shed has a concrete floor, it may be covered with a movable wood floor, or a small section of such flooring may be provided on which the goats may sleep.

Each stall, of whatever type, should provide a manger for hay and a place for the pan in which the concentrates are fed; or, if the shelter is not so elaborate, pans for feed and pails for water are provided. These may or may not be placed in racks at a convenient height from the floor.



END ELEVATION FRONT ELEVATION

Ideal small barn for goats. (*Dairy Goat Journal.*)

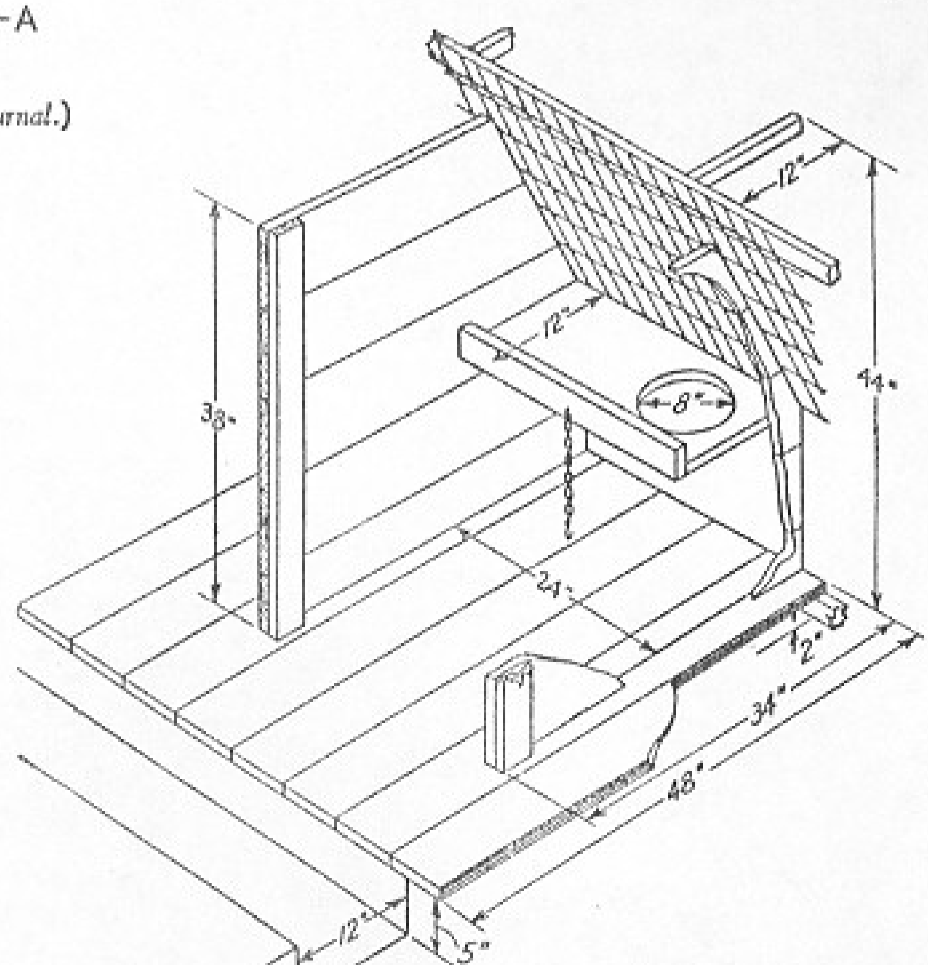


FLOOR PLAN SECTION A-A

An ideal small barn for goats. (*Dairy Goat Journal.*)

Bill of material needed for small goat barn illustrated

4½ yards concrete (1-2-4) 1 part cement, 2 parts sand, 4 parts broken stone.
1—4" hard tile P trap.
10—1'4" hard tile. Note: Tile figured to outside of building only.
1—6" × 6" C I floor drain for 4" tile.
6—2" × 4" × 10' plates.
6—2" × 4" × 18' plates.
42—2" × 4" × 8' O S studding.
1—2" × 4" × 14' O S studding, gable.
10—2" × 4" × 7' studding, milk room.
20—2" × 4" × 8' rafters.
1—1" × 6" × 18' ridge.
600 ft. B M 1" × 6" cove siding.
4—1" × 3" × 9' corner boards.
4—1" × 4" × 9' corner boards.
3 rolls 3-ply roofing.
33 lbs. 8d common nails.
10 lbs. 10d common nails.
5 lbs. 20d common nails.
1 lb. 8d casing nails.
1 lb. 10d casing nails.
2 pairs 8" T hinges.
340 ft. B M 1" × 6" flooring, roof sheathing.
630 ft. B M 1" × 6" flooring, inside lining.
10—2" × 4" × 10' joists, loft.
180 ft. B M 1" × 6" flooring, loft.
1—2'8" × 6'8" × ⅞" batten door.
1—2'8" × 6'8" door frame, 4¼" jambs, ¾" × 3¾" casing, 2 sides.
4—1'8" × 2'5" × 1⅜" casement sash (see detail).
4—1'8" × 2'5" × 1⅜" casement sash frame (see detail).
4—1" × 6" × 8' verge boards.
4—1" × 4" × 12' facia boards.
4—1" × 4" × 6' frieze boards.
1—8" hasp.
1 rim lock, milk room.
1 inside door bolt.
4 pair sash fasteners.
4 pair 2" × 2" butts.
2 rolls 1-ply tar paper.
12—½" × 10" anchor bolts.
2 gal. outside paint.
5 rolls of building paper.



A goat stall. This type of stall has proved popular, as it affords economy of feed and efficiency in handling the feeding operation for goats. (*From Carl A. Leach, Aids to Goat Keeping.*")

Commercial firms make all goat equipment including mangers, milk stands, feeding pans, water containers, and all other essentials. Anyone handy with tools, however, can make these things at home. A local tinner can make any type of feed pans desired. Some one-pound coffee cans (if still available) are about the right size and shape.

It goes without saying that the quarters should be cleaned daily—twice each day in hot weather. A good disinfectant should be used about once each week.

Feeding Goats

Goats are fed in the same way as dairy cows; they have the same requirements. The only difference is in the quantity of feed consumed. The feed needed to support one dairy cow will feed six or eight goats. Goats are natural browsers. They like grass, hay, and tender sprouts of trees and shrubs. Pastures are desirable, but not necessary. During the summer months the goats may be tied out to get some green feed, sunshine, and exercise. Even in the colder seasons they should be allowed to go outside for exercise and fresh air.

We are primarily interested in the feeding of goats in milk. Such goats should get all the legume hay they will eat. Leafy, green alfalfa is preferred by most feeders. Any of the clovers or other legumes will serve quite well. Succulent feeds are desirable—grass in summer or perhaps leaves of cabbage, lettuce, carrots, or turnips. In addition, a concentrated feed of grain and protein and minerals must be used. For one or two goats it is assumed that the owner will buy commercially mixed feeds, of which there are several on the market. Milking goats should be fed such a concentrate twice each day, morning and night—about 1 qt. each time.

"The Purina Goat Book" summarizes feeding practices for goats of all ages and conditions in the table shown on pages 142 and 143.

For the trade-name feeds given in the outline those of other commercial concerns may be substituted. Every large feed-making company has a line of goat feeds to sell. Vitality Mills, Board of Trade, Chicago, for example, has a goat-feeding plan based upon the feeds it sells in which grain combinations are staggered with pelleted feeds. These feeds and the plan for using them are endorsed by many goat raisers.

Commercial feeds are convenient. They are scientifically compounded. They contain all required nutrients in the proper balance, and they are registered in the states where available and sold under guarantees protected by the laws of the state.

If one prefers to mix his own concentrated feed, the following formula will prove quite satisfactory: 100 lb. corn, 100 lb. oats, 50 lb. bran, and 25 lb. linseed meal. The quantities may be increased or decreased in relative proportion as desired.

Block salt should be kept before goats of all ages at all times.

Clean water is essential. It should be kept before the goats at all times, or fresh water may be given the goats three times each day. In the winter warm, even hot, water is appreciated. Goats, like dairy cows, should be encouraged to drink all the water they will consume.

FEEDING DIRECTIONS

The secret of feeding goats is to hold an edge on their appetite by not overfeeding. Keep them always eager to eat more

	How and what to feed	Hay
Kids	First 2 weeks: Remove kids from mother at birth. Feed warmed mother's milk from bottle or pan at least four times a day. Kids will consume about 1½ qt. of milk daily. 2 weeks to 6 weeks: Continue to feed same amount of milk until 4th week. Allow kids to have Purina Calf Startena along with the milk twice a day. Beginning at 5th week, start increasing amount of Calf Startena and decreasing amount of milk so that kids can be weaned when 6 weeks old.	Kind: Fine leafy or chopped (4-in.) alfalfa. Amount: Keep before kids at all times. How fed: Trough, protected so that kids cannot trample in it and get it wet.
Growing goats	6 weeks to freshening: Keep Purina Calf Startena in front of kids at all times. Retain just enough Calf Startena in troughs to last from one feeding to the next. Feed twice a day. Do not allow feed to pile up or remain in troughs to become spoiled or molded. Kids do not like it and it may cause scours.	Kind: Fine leafy or chopped alfalfa. If kids show any tendency to scour, switch to mixed timothy and clover hay. Amount: Approximately 3 lb. per day. How fed: Trough.
Dry goats	Goats need a 2-month dry period to rebuild body condition before starting to milk again. For first part of dry period feed good hay or pasture. Last 4 weeks before freshening: Feed 1½ qt. Goat Chow morning and night (3 qt. daily), along with good hay or reasonably good pasture. If on exceptionally good pasture, Goat Chow may be reduced to 1 qt. morning and night (2 qt. daily).	Kind: Alfalfa, not chopped. Amount: Keep plenty of hay before the goats at all times. Dry goats should eat 5 to 6 lb. of hay daily. How fed: Have hay rack or trough protected so that goats cannot trample in hay.
Milkers	1 qt. morning; 1 qt. night Green grazing when possible	Same kind and amount as for dry goats: When on pasture, hitch goats in front of racks or mangers 30 min. before milking, to make sure they get enough hay.
Bucks	Growing and service bucks: Feed 2 to 3 qt. Goat Chow daily.	Same as for dry goats

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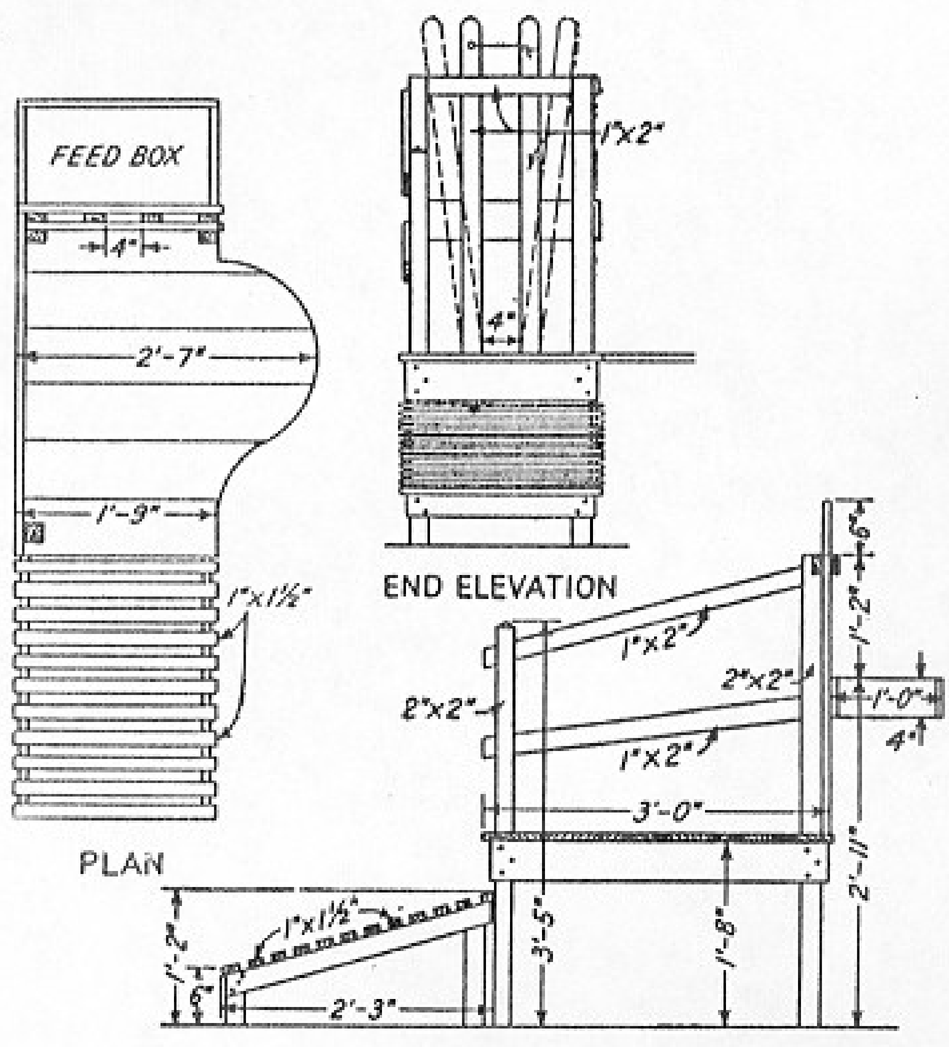
In general, it may be said that every rule that applies to the feeding of cows is applicable to the feeding of goats. The quantity of grain or concentrate, for example, may be increased a little as long as the milk flow increases. Feed is the raw material from which milk is made. Also, the anatomy of the goat, like that of the cow, is designed primarily for roughage—concentrates are fed as a supplement to hay and other bulky feeds.

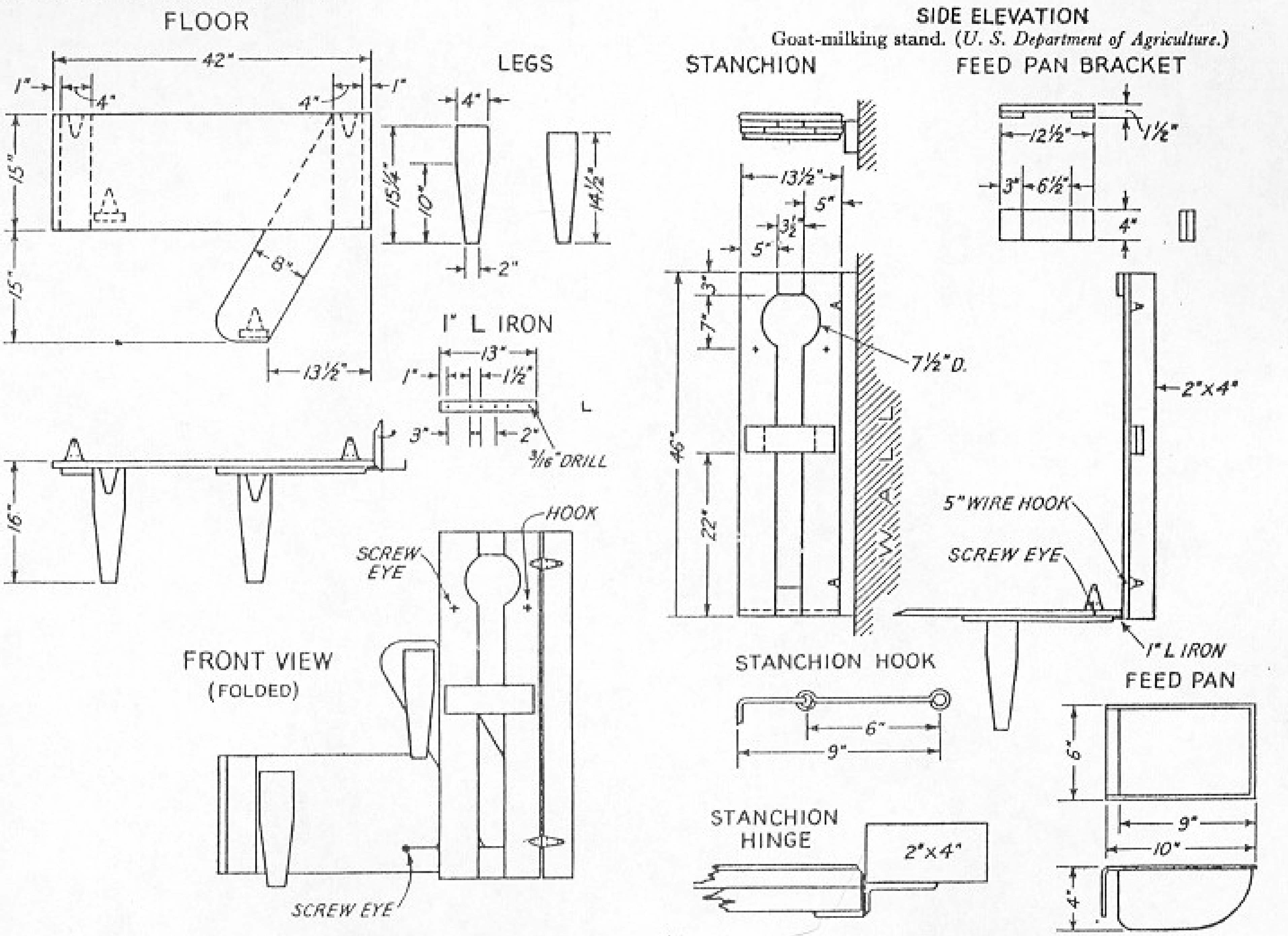
Milking Your Goats

Goats should normally be milked twice daily—at morning and at night. High-producing goats, like record-breaking cows, may be milked three times daily, at 8-hr. intervals. It is said that milking three times each day will increase the milk production 20 per cent. But labor is a factor to be considered; as a daily chore, milking twice better fits the work or school schedule of most urban families.

For the convenience and comfort of the milkers, stands are usually provided for milking goats. These are little platforms about 18 in. high, 2 ft. wide from front to back, and 3½ to 4 ft. long. In the front is a stanchion



Goat-milking stand. (*U. S. Department of Agriculture.*)



Plans for making the folding milk stand. (*From Carl A. Leach, "Aids to Goat Keeping."*)

through which the goat puts its head. There may be a small feedbox in front of the goat so that it can nibble on some feed while the milking is in progress. Milk stands are of two types. They may be complete and movable units so that they can be placed outside the barn or shelter in good weather, or they may be attached to the interior wall of the barn or shelter. Those of the latter type are ordinarily made so that they can be folded back against the wall while not in use.

Goats are normally friendly and obedient animals. They soon learn to mount the platform at milking time. A run-up from the ground, in the form of a cleated ramp, should be a part of the stand or provided as a separate piece of equipment. The milker may sit on a box, as in milking a cow.

Before milking, the udder should be washed with a warm cloth and dried. The hands of the milker should be clean and dry. A goat should be milked from the same position as a cow—the right side. Unless the teats are very small, the same grip and processes should be followed as suggested for milking cows. If the teats are too small, then the *stripping* technique may be used. As in the case of a cow, the doe should be milked *dry*. Otherwise the quantity of milk produced will decrease rapidly.

As soon as the milking has been completed the milk should be strained. Single-use strainer pads are recommended. Of course, a cloth may be used, but, if it is, it should be boiled each time before it is used again. The milk should be precooled before it is placed in the refrigerator, as is suggested in the case of cow's milk. Pint or quart bottles are convenient containers for keeping the milk while in the refrigerator.

As has been already noted, butter and cheese may be made from goat's milk if one wishes and has a sufficient quantity. It is assumed, however, that in most cases the city family with one or two goats will not accumulate enough milk to make these products, as there are so many other ways in which the milk can be used. The "cream" does not rise to the top of the container so quickly, completely, or easily as is the case with cow's milk. By placing the milk in shallow pans, instead of bottles, one can get the cream to come to the top so that it may be skimmed off for butter making or other uses. The butter made from goat's milk tends to be white, like lard or shortening; color should be added, as is usually done with cow's milk during the months when the cows are not getting green grass on pastures. Goat cheese is an excellent product. Recipes for making it may be obtained from the U. S. Department of Agriculture, Washington.

Whipped cream, ice cream, and all other dairy products may be made from goat milk. It may be used in cooking in the same way as cow's milk, like quantities being used in recipes calling for milk.

It is assumed, of course, that the major portion of the milk produced will be served as a beverage as cow's milk is used by those who have a sufficient quantity. Children should drink some milk at every meal. It should be served very cold. Interestingly enough, goat's milk in some countries is served hot, but most Americans will not like it that way.

Breeding the Does

The lactation period in goats, that is, the length of time intervening from the date of freshening until going dry again, is from 3 to 10 months. Perhaps the average is from 7 to 10 months. Some does will give milk for a longer period than 10 months. The better the breeding of the individual, the longer the lactation period. Purebreds of the leading breeds are usually superior to grades in this respect.

Does are usually bred the first time at from 15 to 18 months of age; but well-developed does may be bred at an earlier age, perhaps when only 9 or 10 months old. After kidding the first time, a doe is bred once each year. The gestation period is from 145 to 155 days in length. Roughly, it may be said to be a period of 5 months. This means the time that elapses from the date of service until the kids are born.

Normally the breeding season may be regarded as the period from September until January. The first period of estrus (heat in does) may occur in August. Unless the doe is bred, it is possible that heat periods will develop after January. This, along with a consideration of the lactation period, explains the reason for keeping two does instead of one. If one of the does can be bred in August or September, she will freshen in December or January. If the second is bred in December or January, she will freshen in April or May. Such a plan will provide a year-round milk supply at about a constant level; that is, practically the same amount of milk will be available at all times. Naturally, during the lactation period the amount of milk given changes. It will increase for several weeks, remain for a period of months at a more or less constant level, then tend to decline.

One may dry up a goat by skipping a milking period every day for a while, then skipping two milking periods at regular intervals, then three, then four.

The heat period in does may be detected by nervousness, twitching of the tail, and other unusual actions. When it appears the first time—say, in August—the period will be very short, possibly not more than a few hours in length. If the doe is not bred at that time, the period will reoccur every 17 or 21 days, although the

period of reoccurrence will vary with individuals. Each time, for 2 or 3 months, the period will be increased in length until it extends over two or more days.

Naturally, the owner of a back-yard goat will not keep a buck, but at the cost of a small service fee the doe may be bred at any goat-breeding farm or dairy. Arrangements, if desired, can be made by any veterinarian.

Goats are prolific. Twins are more frequent than single kids; triplets are not uncommon. A beginner in dealing with the period of kidding, which will be approximately 150 days after the doe has been bred, may wish to call a veterinarian to advise him as to the proper procedure. After the first experience, this will be unnecessary.

What should be done with the kids? This is a debatable question. Experts advise that they be killed at once. Especially is this advice given with respect to male kids. It is pointed out that the city or town owner does not wish to keep bucks. They may be raised and killed for meat, but by the time they have reached the desirable age for slaughter they have become pets, and one can neither kill nor eat a pet. In any event, the milk given by the mother is not to be used as human food for several days. If the kids are kept, it may be milked and fed to them from pans or bottles.

After kidding the mother goat should not be fed much grain for several days; then the amount must be increased gradually until she is on the full feed ration recommended for milking does. During this period she should have an abundance of clean, fresh water, possibly warm or hot water if the weather is cold.

Health Rules

Goats are healthy creatures. Little trouble need be anticipated. But, even so, disease and ill health are the bane of every animal keeper's existence. You must protect the health of your goats in every way possible. Here are some of the rules that seem worth while.

1. Do not let goats run on damp ground.
2. Never let the bedding stand long enough to get wet and soggy.
3. Always keep feed off the floor of goat pens.
4. Keep the goats in a dry, well-ventilated place, and out of drafts.
5. If vermin come, use a powder to kill them.
6. Call a veterinarian in case of sickness.
7. Start out with healthy stock and feed in accordance with directions.

Very little trouble will come if goat owners follow these health rules and the principles of good management.

Why not act upon the proposed Victory slogan and keep a doe—or even two does? You can make yourself independent of the milkman by keeping in your own back yard one or two of these friendly animals that are "producers of nature's most perfect food for man."□

WHY NOT RAISE SQUABS?

The squab is a delicacy that may be enjoyed by everyone. There is no living creature more prolific or easier to produce than the pigeon.

In the United States squab production is a growing industry. For the most part, it is located near large cities, which supply desirable markets. The squab is still a luxury food, however; it sells for a very high price, as compared with other meats. When 1 month old squabs are ready for market; at that age they weigh a little less than 1 lb., yet often sell in retail markets for as much as $1. An average price of 50 or 60 cents a pound has been realized by producers over a long period of years, including the very low price of 25 cents a pound in 1932.

Squab production has several advantages, when compared with the growing of chickens. *First*, the birds maintain maximum production for a period of 5 years or more—no replacements of breeding stock are necessary during this period. On the other hand, you know that hens attain maximum egg production during their first mature year, and after that production falls rapidly. As a consequence, new chickens for the laying flock must be provided each year. *Second*, pigeons are not so subject to disease as chickens. *Third*, pigeon parents raise, protect, and feed their young. Baby chicks must have constant care. Thus, the work involved in growing squabs for home use or for market is not so great as that involved in the production of fryers and broilers.

The greatest disadvantage in growing squabs as compared with broilers is that the parent stock must be kept and fed the year round. One may, however, go in and out of the chicken business within a period of 12 weeks. For example, a city family may buy a number of baby chicks in March and by the end of May have produced 100 broilers. At that time, the chickens may be dressed and put in cold storage. Within the short space of 12 weeks a year's supply of poultry meat for the family has been produced and all the work involved has been done. On the other hand, the pigeons producing squabs must be maintained and fed throughout the year. It is true, of course, that the work involved is not burdensome; the cost is not large; and the squabs are produced in such a way as to furnish a continuous supply of meat throughout the year.

Squab meat is dark in color. It has a unique flavor. Not everyone likes squab as well as chicken.

Chronology of a Squab

Squab is, of course, the name applied to a young pigeon. Old pigeons may be eaten—often in a pigeon pie—

but they are not so desirable. Pigeon breeders cull their birds, just as poultrymen eliminate their older hens from laying flocks. The older pigeons are sold at relatively low prices, perhaps 25 cents.

Pigeons are very prolific. Before the Christian Era, an advocate of pigeon production recorded the following observation: "There is no creature more prolific than the pigeon, and so in the short space of 40 days it conceives, lays, sits, and brings up its young. And they go on doing this almost all the year around."

Rumor has it that pigeons do not breed in February. This is not correct; February is one of the most productive months. It is only during the moulting season in the fall that breeding stops. Some pairs of pigeons produce young ten or eleven times during the year.

The love life and habits of pigeons are interesting and quite unique among our domestic creatures. They normally mate once during their lifetime. If large numbers of males and females are together in a flock, each will select a mate. Each male will be seen to select and follow (or drive) one female. They live together; they sleep together; they work together. The task of hatching the eggs is shared, as is the job of feeding the young. Should the male or the female die, the one remaining will choose another mate after a time. Forced mating may be brought about; that is, a male and a female may be put into the nest or enclosure and the law of proximity will usually operate to bring about the desired results, but not always.

Stray and unattached males in the loft are undesirable. They bring about domestic discord. Incidentally, it is often difficult to distinguish male from female birds.

Feeding the young is unique. Alfred R. Lee, in his publication "Squab Raising" (*Farmers' Bulletin* 684, U. S. Department of Agriculture, Washington) makes the following statement about it.

> Squabs are reared and fed by both parent birds on a thick, creamy mixture called pigeon milk, prouced in the crops of the pigeons. The parents usually feed their squabs shortly after they themselves are fed, and should not be disturbed at that time, thus making it desirable to water them before they are fed. Care should always be taken not to frighten pigeons. Squabs should not be disturbed any more than is necessary. If the parent birds die, the squabs may be removed to a nest where there is only one squab, or they may be fed artificially, although this process takes considerable time.

The life history of a squab, in chronological sequence, is about as follows:

Parents.—Pigeons mate and begin breeding at the age of 6 or 8 months. (Beginners in squab production should buy mated pairs; relatively young birds are desirable.)

Eggs.—Females lay an egg, skip a day, lay another. (Only two eggs should be hatched by a pair at one time, as they can feed and care for only two squabs.)

Hatching.—The period of incubation is about 17 days. (Both parents sit on the eggs—the male shift may be from 8:00 A.M. to 4:00 P.M., at which time the female takes over.)

Squabs.—At 4 weeks of age the squabs are ready for market. (At this age no pin feathers should be visible on the under side of the wings.)

Pigeons may be kept in the back yard. Strange to say, almost no city ordinances mention pigeons as being objectionable. If they are kept in a sanitary condition, there are no reasons from the standpoint of health why the birds may not be kept on any city lot.

Small boys build pigeon houses and allow their birds to fly at will. *This is not desirable.* Persons producing squabs for meat should confine their birds. A loft should be provided. This is not unlike a chicken house and yard, but may not be so large.

Commercial squab producers expect to make $2 or $2.50 annually per pair above feed costs. Returns compare favorably with poultry enterprises.

The first job of the beginner will be that of buying breeding stock.

Buying Breeding Stock

Persons wishing to raise squabs for meat must buy breeding stock in pairs. The number of pairs one should purchase may be determined solely by the quantity of squabs desired.

While it is much like counting one's chickens before they hatch, it may be assumed that each pair of pigeons will produce a dozen squabs each year. Therefore, eight pairs of mature birds should supply about 100 squabs annually.

Where may one discover a source of supply? In all probability there is a pigeon breeder living in your community. If not, you may find it interesting to go to your local newsstand and buy a periodical devoted to piegon production—perhaps, the *American Pigeon Journal*. In it you will find a list of breeders with stock for sale. Well-informed poultrymen will know the names and addresses of pigeon fanciers; poultry journals contain their advertisements. Your state agricultural college will locate a source of supply. The Poultry Section, Bureau of Animal Industry, U. S. Department of Agriculture, Washington, has published a bulletin, "Squab Raising" (*Farmers' Bulletin* 684); the specialists in this bureau will aid you in locating convenient sources of supply.

There is no necessity of buying pigeons in the locality in which you live. They may be shipped to you by express from any section of the United States. But you should buy the *breeds* desirable for squab production. After all, there are many kinds of pigeons. Some are kept merely as pets. A number of breeds and strains have been developed, however, solely for the production of

squabs for meat.

Also, you should buy from a breeder who has made an effort to improve his birds by constant selection for greater production. If work of this kind has been done, the breeder will inform you of it when offering birds for sale.

The breeds listed below are recommended as being best adapted to the production of squabs.

King.—One of the most popular squab producers.

Carneau.—Selected by many as most desirable.

Swiss Mondaine.—Not so widely distributed, but an excellent breed.

Homer.—A very good producer of small squabs.

Runt.—Largest of all breeds.

Hungarian.—Produced more often for exhibition than for the raising of squabs for meat.

Prices will depend upon the excellence of the birds and the reputation of the breeder. Local producers will sell surplus stock at very low prices. It may be desirable to buy a limited number of very fine birds and allow breeding stock to increase to the desired maximum; after all, this can be done very quickly, as the females begin laying eggs when 6 or 7 months of age.

In his complete and interesting treatise, "The Pigeon" (R. L. Bryan Company, Columbia, S. C.), Wendell Mitchell Levi lists the following as among the largest squab farms in the United States: Dyer and Davis, Newfield, N. J.; George W. Middleton and Sons, Norristown, Pa.; Carpenter Squab Ranch, La Canada, Calif.; Palmetto Pigeon Plant, Sumpter, S. C.

Equipment for Producing Pigeons

The following equipment is required for growing pigeons: (1) *house and yard*, (2) *feed trough*, (3) *drinking fountain*, (4) *grit box*, and (5) *bath pan.*

The house and yard may be of any size to accommodate the number of pigeons one wishes to keep. A house or shed 12 by 12 ft. in size, and a yard of the same size, will provide ample space for 32 pairs of birds.

In such a house, a passageway at the back 3 ft. wide, with a door on one side, should be provided. This aisle or passageway is separated from the remainder of the house with wire netting (commonly called chicken wire), which extends from the ceiling to the floor—or almost to the floor as will be noted later. The feed trough is placed in this passageway on the floor and against the partition. Such an arrangement makes it possible for the attendant to feed the birds without entering the house in which the nests are located.

The nests are placed on the side walls, 16 on each side. The tiers of nests are four by four, that is, four nests wide and four nests high. Each is a double nest, or family apartment. Such a nest is almost exactly like an orange box, which, as you know, has a partition or division board in the middle, dividing the box into two equal parts. As a matter of fact, many persons who raise pigeons in the back yard use discarded orange or lemon boxes for nests. These serve the purpose very well, but built-in tiers of nests—each with a board extending a few inches in front to serve as a perch or front porch—are more desirable.

The upper half of the front of the house, which leads to the yard, may be left open. This permits the birds to fly out of the house and into the yard at any time. The lower half should be closed. Such an arrangement allows a free movement of fresh air; at the same time it protects the birds from inclement weather—for the roof in front extends perhaps 3 ft. beyond the upright boards in the front wall, and the roof slopes downward at such an angle that no rain or snow can fall or blow inside. Because of the way in which the front of the house is built, it should not face the prevailing winter winds.

The yard is directly in front of the house. It is made of a framework of 2- by 4-in. boards and covered—top, front, and sides—with wire netting.

As previously stated, the feed trough is placed in the passageway at the back of the house or shed. A trough of any material will be satisfactory. In shape and size it should look about like the gutter on a house, shallow enough so that the birds can reach the feed at the bottom. Also, the chicken-wire screen netting in the partition should be replaced about 6 or 10 in. above the floor with little boards (like laths) about 2 in. apart, so that the birds will not have difficulty in getting to the feed in the trough. *By placing the feed trough outside the house, it is kept clean at all times.* It is also more convenient for feeding. You will recall that one should disturb the pigeons as little as possible.

As is the case with chickens, the drinking fountain should be purchased at a feed store. If 32 pairs of birds are kept in the house it is important that the fountain should be large enough to provide an ample supply of water at all times. Of course, a pan may be used for supplying water, but it will be turned over, the water will soon get dirty, and it is otherwise objectionable.

Any container will serve as a grit box, *but it must be covered.* For example, a pie pan with a wood-frame cover —solid top, open sides—will serve admirably.

A dishpan will serve for the bath or any similar type of pan may be substituted. In warm weather the birds like to splash around in water, especially in the bright sunshine. If there is an opening in the wire netting in the yard, the bath pan filled with water may be put in place without entering the yard.

The bath pan is kept in the yard; the water fountain and grit container on the floor inside the house where the

birds live; the feed trough in the passageway outside the enclosure or compartment that constitutes the living quarters. An attendant need enter this part of the house or loft only to fill the containers for supplying water and grit, and, when necessary, to inspect the nests, or to remove the squabs.

The house or loft described is not large as compared with laying houses for chickens, yet it provides adequately for a much larger number of squabs than may be required by many families. A much smaller house will serve quite well for a smaller number. Of course, the feeding may be done by hand; that is, the grain may be scattered in the screened or wired yard or enclosure.

BILL OF MATERIAL

Pigeon loft and flypen
House 14′ × 9′
Flypen 12′ × 9′

2 pieces 4″ × 6″ × 14′ (rough for sills)
2 pieces 4″ × 6″ × 9′ (rough) for sills

5 pieces 2″ × 4″ × 9′ (rough) for floor joists

4 pieces 2″ × 4″ × 12′ (dressed) for back-wall studs
9 pieces 2″ × 4″ × 14′ (dressed) for end studs, door posts
2 pieces 2″ × 4″ × 9′ (dressed) for plates
6 pieces 2″ × 4″ × 16′ (dressed) for rafters (long)
6 pieces 2″ × 4″ × 5′ (dressed) for rafters (short)

170 ft. tongue-and-groove flooring
280 ft. common weather boarding
220 ft. sheathing for roof
2 squares of tin or suitable roof

1 piece 1″ × 12″ × 9′ (dressed) for back window
50 lin. ft. 1″ × 4″ (dressed) for 2 doors (one for fly)
9 lin. ft. 1-in. mesh wire 1 ft. wide for back window
9 lin. ft. 2-in. mesh wire 6 ft. wide for aisle partition

120 bricks, ¼ yd. sand, 1 sack lime, 1 sack cement,
2 cu. ft. rock for concrete base in front of fly

Flypen
2 pieces 2″ × 4″ × 12′ (dressed)
2 pieces 2″ × 4″ × 14′ (dressed)
3 pieces 2″ × 10″ × 12′ (rough)
33 lin. ft. 1-in. mesh wire 36 in. wide for sides
18 lin. ft. 1-in. mesh wire 48 in. wide for top

Hardware
2 pairs 3-in. strap hinges for back window
2 pairs of spring hinges for wire doors
1 pair 8-in. strap hinges for outside aisle door
2 hasps and staples
2 padlocks

NOTE.—Material for nests is not included.

Feeding Pigeons

Several methods of feeding pigeons are practiced.

Most owners prefer the aisle-feeding-trough method. Under this plan feed is placed in the troughs twice a day —in the morning and the afternoon. As much feed should be placed in the troughs as the birds will eat, but no more. Do not feed too late in the afternoon; birds retire early, you know.

Some producers like the self-feeder plan, such as is commonly used in feeding swine. Feeders are of two types —those with one compartment containing a mixture of grains; those with several compartments or bins, each containing a different kind of feed. The advantage of the self-feeder plan is that the bins may be filled once with a supply sufficient to last for several days. The disadvantage is that the birds may eat too much and become sluggish; also, in the case of pigeons, this method tends to waste feed.

Pigeons require several grains in their ration. This is essential to proper balance. The following mixtures are recommended. The additional corn in the winter ration increases the energy- or heat-producing content of the feed.

Cold-weather Feed Mixture	Per Cent	Hot-weather Feed Mixture	Per Cent
Yellow corn	35	Yellow corn	20
Peas	20	Peas	20
Wheat	30	Wheat	25
Kafir	15	Kafir	35

Ingredients for this feed may be purchased at any good feed store. Also, it is possible in most feed stores to buy a commercially mixed pigeon feed, just as one may buy broiler mash and other feeds required for chickens. Bags of all sizes are available, from those holding as little as 5 lb. to bags containing 100 lb. For a few birds it is hardly worth the trouble to home-mix grains if a prepared mixture designed for pigeons is available.

The Department of Agriculture bulletin "Squab Raising" contains the following suggestions concerning feed and feeding.

> A variety of good, hard, thoroughly dried grain is essential to success. Grains which are in poor condition should not be fed to pigeons. New, soft grains, especially wheat and corn, should never be fed, as they will produce undesirable results, especially in the squabs. The smaller kernels of whole corn, sold as pigeon corn, are preferred—especially the flint varieties. Cracked corn should not be used. Hard, red wheat is considered better than white wheat for pigeons, while some breeders prefer a ration without wheat. Only the best grades of wheat should be used.
>
> Unthrifty squabs may be caused by the use of dirty water, poor quality of feed, lack of proper feed, and by filthy conditions in the pen. Good results may be obtained only when the loft contains selected, strong, healthy, mated breeders, when the quarters are kept clean, and when good feed is properly fed.

Dressing and Preparing Squabs

When they are 3 or 4 weeks old, squabs are ready to eat. At that time they should weigh almost a pound.

Squabs may be picked dry or scalded. The skin of the young birds is very tender, therefore the scalding should be done carefully. The birds should remain in the hot water (about 120°F.) not more than 30 sec. After picking,

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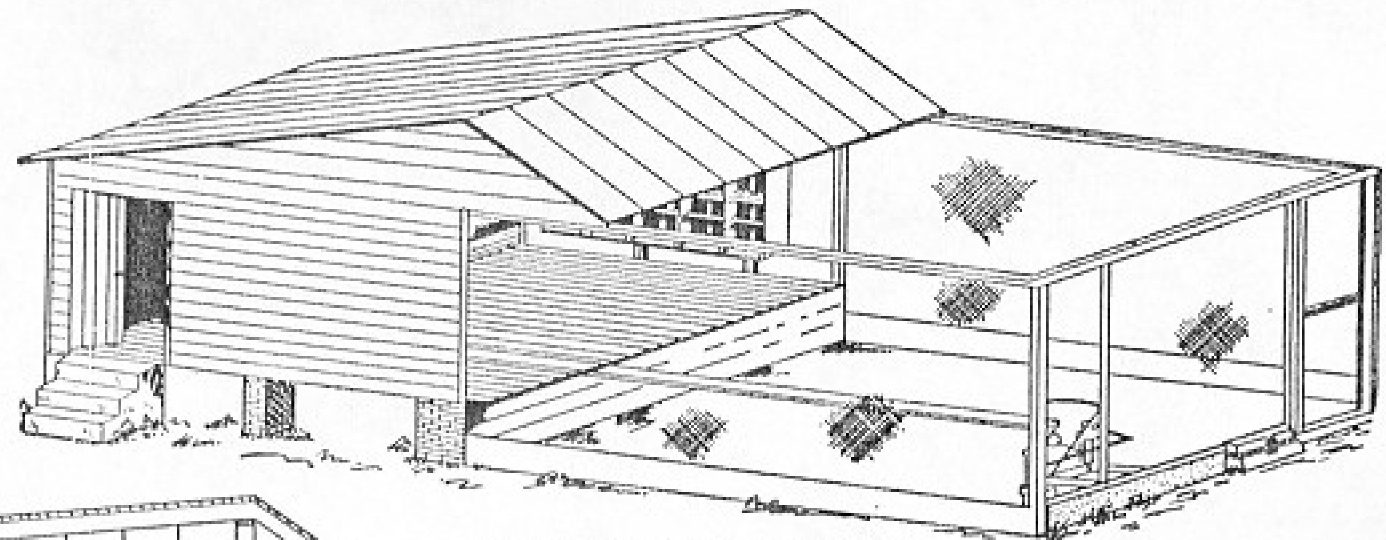
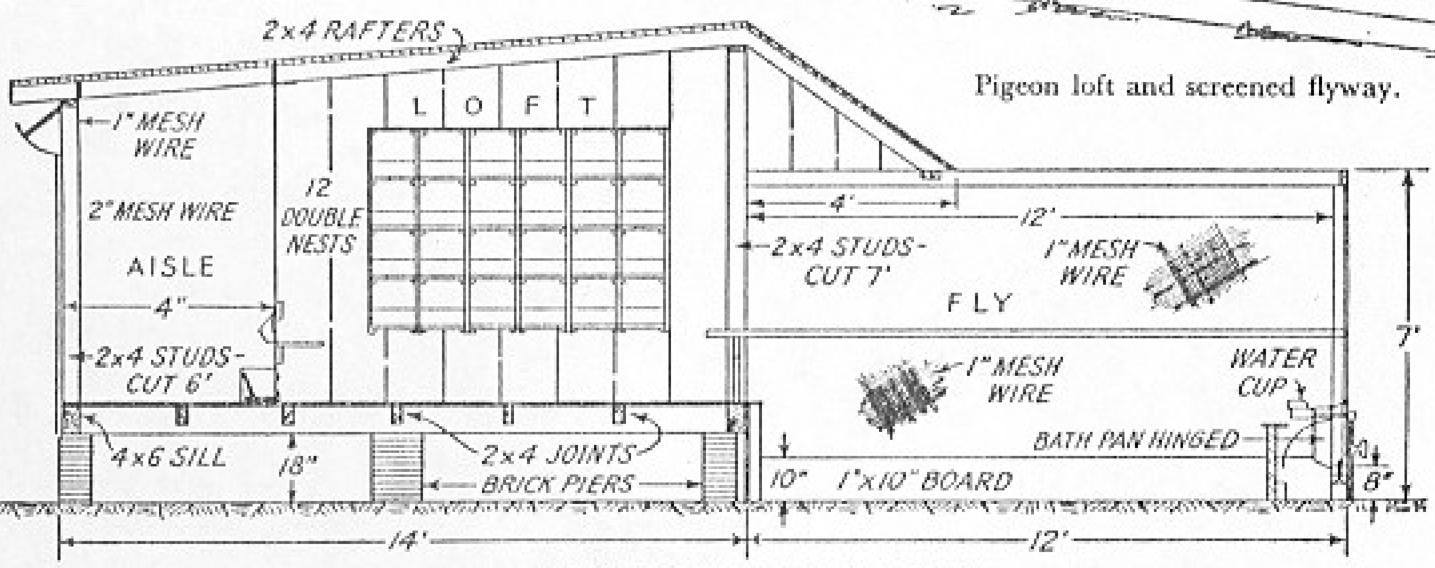
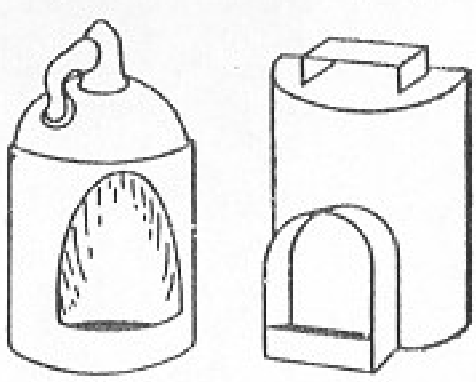


Pigeon loft and screened flyway.

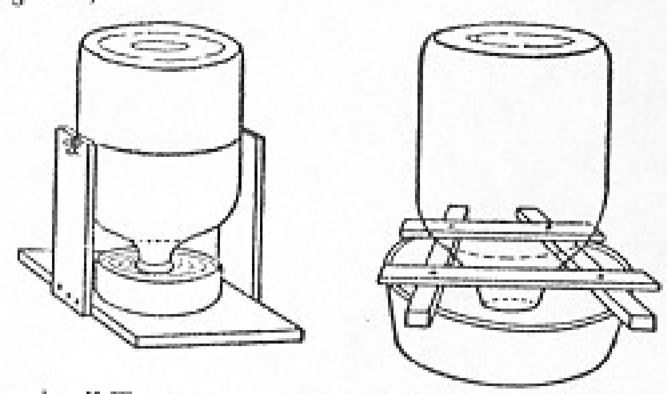


SECTION THRU LOFT AND FLY

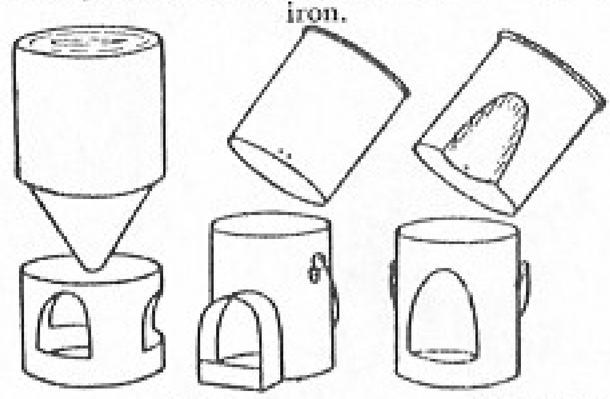
Pigeon loft and screened flyway. (*From Wendell Mitchell Levi, "The Pigeon."*)



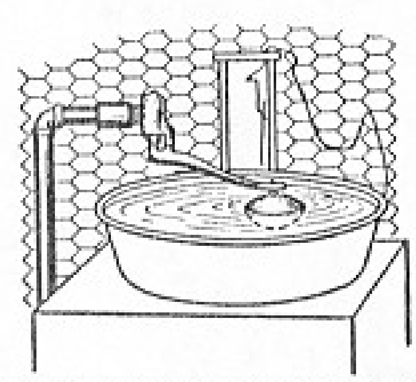
One-piece drinking vessels. Left, stoneware or crockery; right, galvanized iron.



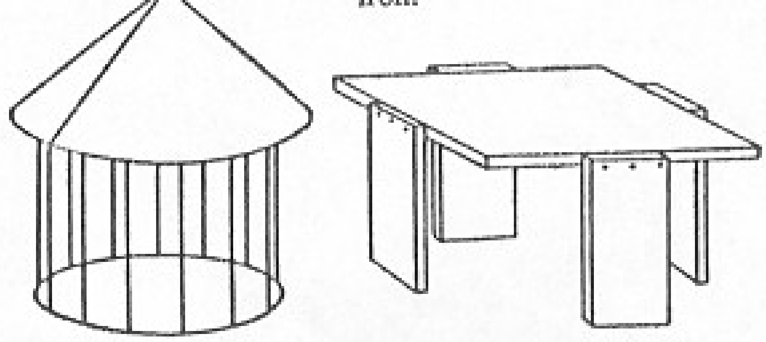
Bottle "fountains." Two methods of supporting 1-gal. bottles for drinking vessels.



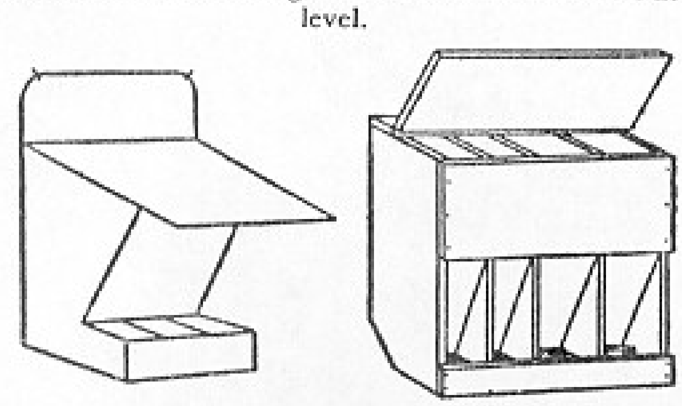
Two-piece drinking vessels. Left, stoneware; center and right, galvanized iron.



A float-valve fountain. This arrangement maintains the water at a constant level.



Grit- or water-pan covers. Two types of protective covers for pans or crocks for grit or water. Left, cone guard and grill; right, platform, or table, guard. (*From Wendell Mitchell Levi, "The Pigeon."*)



Grit hoppers. Cafeteria type; ingredients dry. Left, galvanized iron; right, homemade (wood). (*From Wendell Mitchell Levi, "The Pigeon."*)

the birds may be drawn and cooled in running tap water. They may then be kept in the refrigerator (freezing compartment) until used.

Nothing can add so much luxury to home-produced and home-processed foods as a freezer locker. Quick-frozen squabs may be dressed, frozen, and stored for use in any later month (or year) if one is so fortunate as to be among those renting lockers in a quick-freeze plant. In this way a large accumulation of live birds may be avoided. Such birds not only eat feed and thus increase production costs, but pass the peak of perfection attained in younger pigeons.

Squabs may be cooked in several ways. Favorite methods are as roast stuffed squab, broiled squab, smothered squab.

Roast stuffed squab is prepared like roast chicken or turkey. A sage-and-onion dressing or a celery dressing is recommended (if one can get either sage or celery). *For roasting the birds are not split down the back*, as is done in dressing most small game birds.

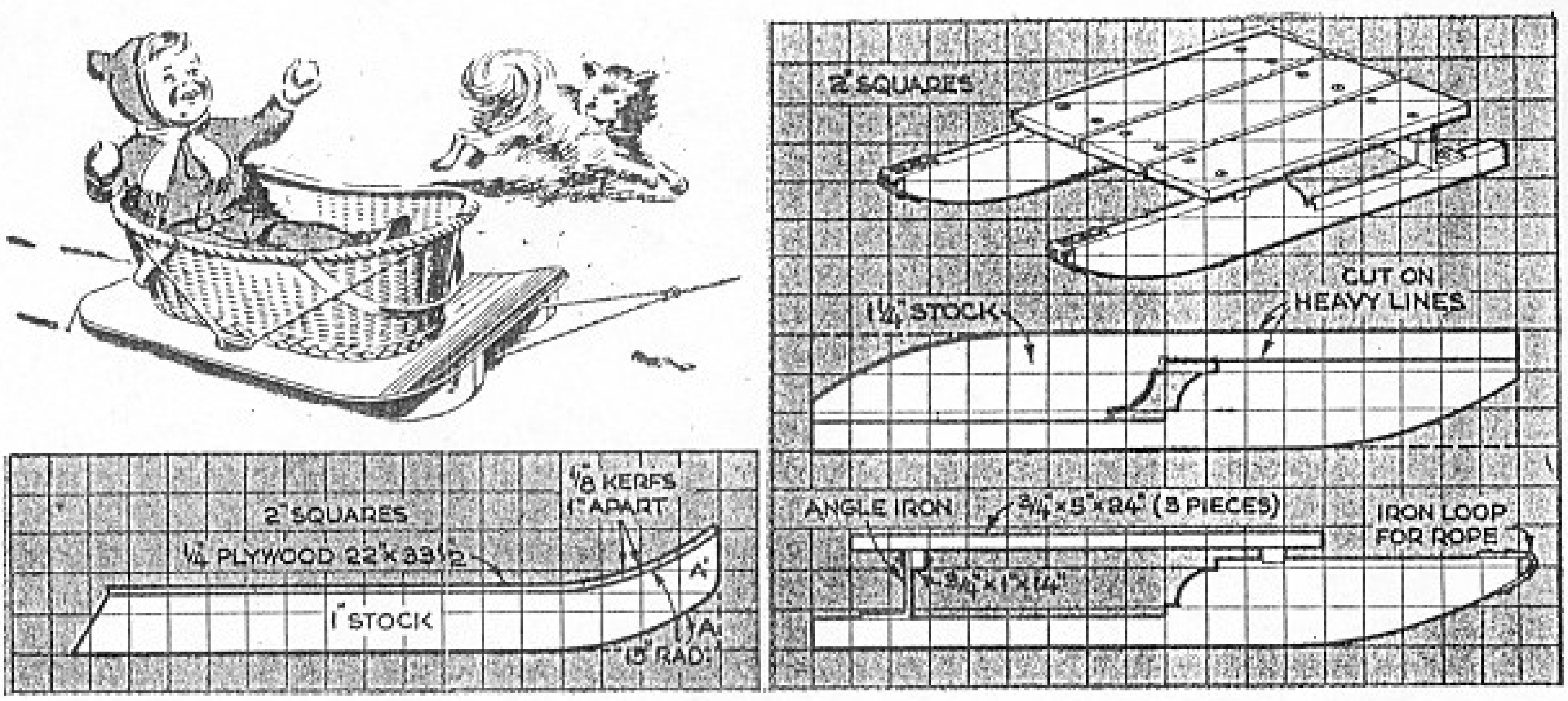
Broiled squab is preferred by many persons. For this method the birds are split down the back. Broil with the breast to the fire, and 5 min. before removing from the broiler, add mushrooms (if available). Broiled birds are usually served on toast.

Smothered squab (Southern style) is suggested by Wendell Levi, who gives the following recipe:

> Prepare as for broiling. Have the frying pan very hot. Melt ¼ lb. butter—for four squabs—place squabs in the butter, and brown. Season with salt, pepper, and Worcestershire sauce. Cover, with lid weighted down. Let steam 10 to 12 min. Add flour, let brown, and add water. Replace lid and cook for 5 min. longer. Place on toast and sprinkle with parsley. Serve with small molds of rice around platter.

Apparently there was no butter shortage when this tempting recipe was formulated.

POPULAR SCIENCE JANUARY, 1946



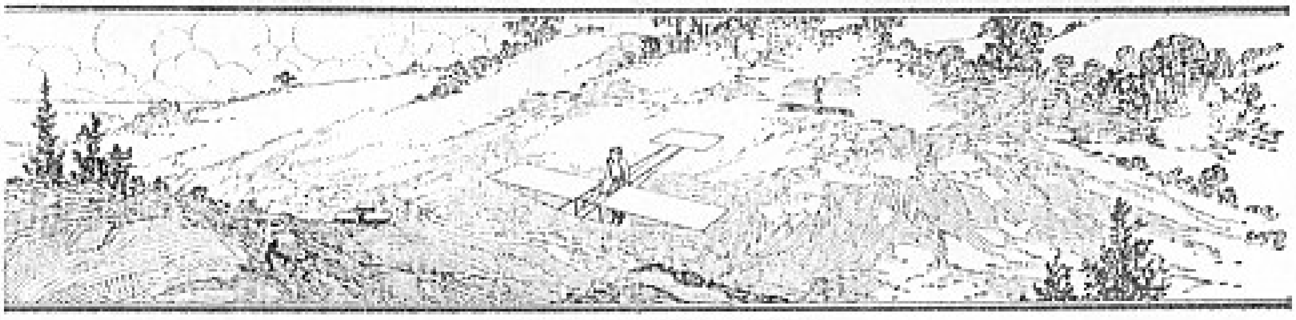
Homemade Sleds for Young Children Are One-Evening Projects

Two sturdy sleds, designed for pulling by hand, are shown in the drawings. Either will carry a small child with little danger of tipping, and may also be useful for hauling groceries or firewood. A clothesbasket screwed to the deck will hold a baby safely, or a low seat with sides may be installed.

Resin-bonded plywood forms the deck of the sled at left, which was designed by G. T. Marris, of Brantford, Ont. It is curved by cutting kerfs in the front, brushing waterproof resin glue into them, and gluing and nailing to the runners. Triangular longitudinal cleats strengthen the joint between runners and deck. These runners are cut from 1" by 3" stock with the waste, shown at *A*, glued and toenailed on as *A'*. Drilled and countersunk steel strips 36" long are held to the bottom of the runners with flat-head screws.

Runners for the other sled, designed by T. MacDonald, of Thornhill, Ont., are cut from 1¼" by 3" stock, as shown. Two angle irons hold the back crosspiece to them, and the deck is screwed on. For easy pulling, runners should be ½" to ¾" further apart at the back instead of parallel.

Finish with varnish and ski wax.



Popular Mechanic 1915

Tandem Monoplane Glider

By GEORGE F. MACE

The monoplane glider illustrated has better fore-and-aft stability than the biplane, is lighter in proportion to the supporting surface, simpler to build, and requires very little time to assemble or take apart. The material list is as follows:

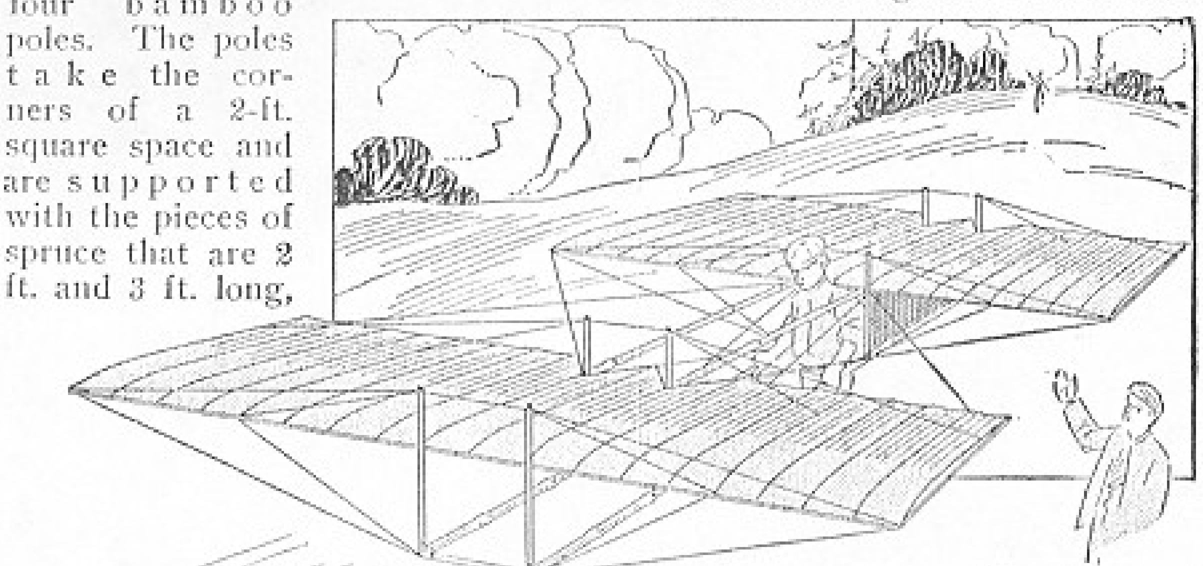
FRAME

4 pieces of bamboo, 14 ft. long, tapering from 1½ to 1 in.
8 pieces of spruce, ⅝ in. thick, 1 in. wide, and 3 ft. long.
8 pieces of spruce, ¾ in. thick, 1 in. wide, and 2 ft. long.

WINGS

4 main-wing bars, spruce, ¾ in. thick, 1¼ in. wide, and 18 ft. long.
8 wing crosspieces, spruce, ¾ in. square, and 4 ft. long.
38 wing ribs, poplar or spruce, ¼ in. thick, ¾ in. wide, and 64 in. long.

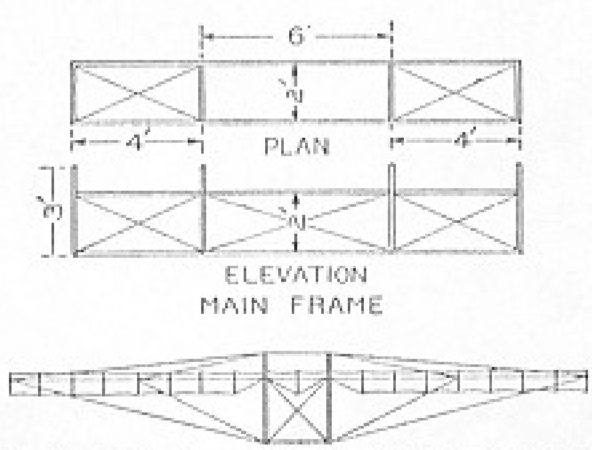
The first thing to do is to make the main frame which is composed of the four bamboo poles. The poles take the corners of a 2-ft. square space and are supported with the pieces of spruce that are 2 ft. and 3 ft. long, the shorter lengths running horizontally and the longer upright, so that each upright piece extends 1 ft. above the two upper poles. All joints should be fastened with $\frac{5}{16}$-in. stove bolts. The wire used to truss the glider is No. 16 gauge piano wire. The trussing is done in all directions, crossing the wires between the frame parts, except in the center or space between the four poles.



The Start of the Glide should be Made from the Top of a Hill, Then a Little Run will Carry the Airman Several Hundred Feet through the Air

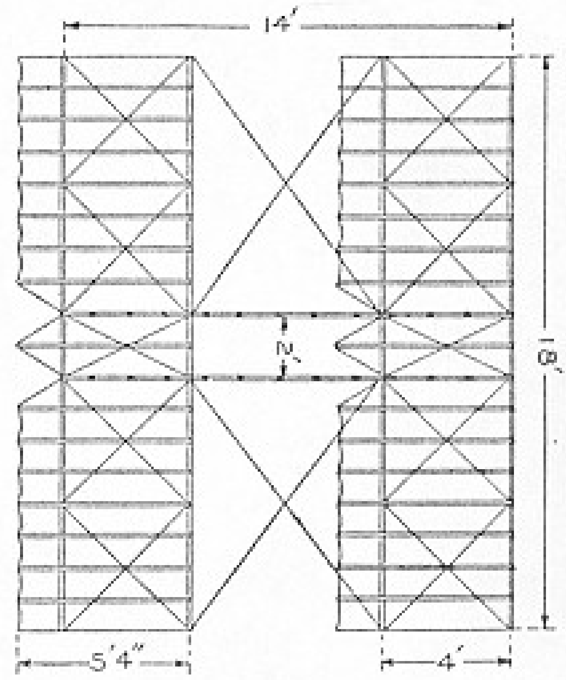
The framework of the main wings is put together by bolting one of the crosspieces at each end of two wing bars, then another 4 ft. from each end, whereupon the wing bars are bolted to the main frame. The frame is then braced diagonally between these pieces. The ribs, spaced 1 ft. apart, are fastened to this frame with 1-in. brads. The ribs are so bent that the highest part will be 5 or 6 in. above the horizontal. The bending must be uniform and is done when fastening them in place.

The material used to cover the wings and rudders is strong muslin. The cloth is first tacked to the front wing bar, then to the ribs, and sewed to a wire which is fastened between the ends of the ribs. Large brass-head tacks should be used through a strip of tape to fasten the cloth to the ribs. The rear wings are constructed in a similar manner. After the cloth is in place it is coated with starch or varnish.



Details of Tandem Monoplane Glider, Showing the Main Frame and Wing Construction, and the Manner of Placing the Crossed Bracing Wires Between the Parts and to the Wing Ends

The two vertical rectangular spaces in the main frame, just under the rear wings, are covered with cloth to act as a rudder. The upper and lower bracing wires for the wings are attached



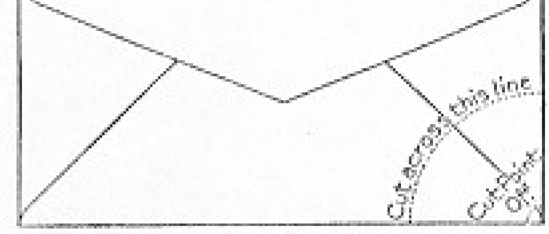
with snaps and rings so that the glider can be easily taken apart.

It is best not to use the glider in a wind greater than 30 miles an hour. It is started from the top of a hill in the usual manner. Glides can be made running from 60 to several hundred feet.

Popular Mechanic — 1913

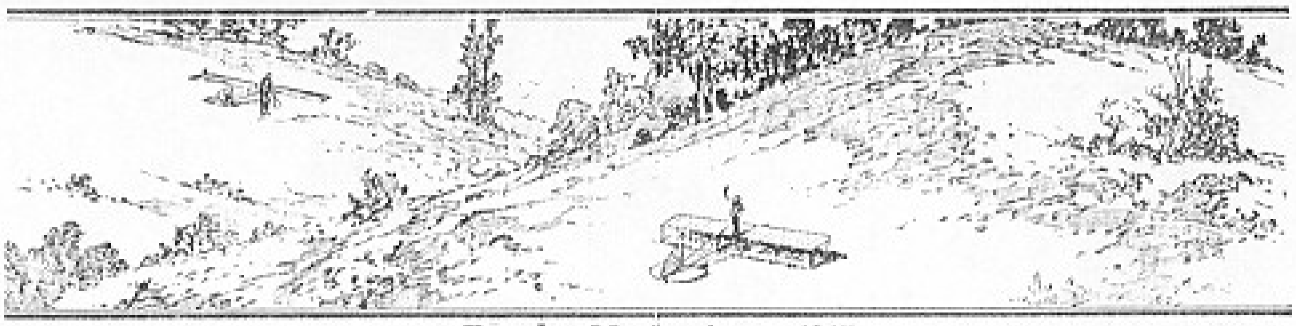
A Temporary Funnel

The amateur photographer often has some solution which he desires to put into a bottle which his glass funnel will not fit, says the Photographic Times. The funnel made by rolling up a piece of paper usually allows half of the solution to run down the outside of the bottle, thereby causing the amateur to be dubbed a "musser." A better way is to take an ordinary envelope and cut it off as shown by the dotted lines. Then clip a little off the



Paper Funnel

point, open out, and you have a funnel that will not give any trouble. It is cheap and you can afford to throw it away when dirty, thereby saving time and washing.



Popular Mechanics — 1915

How to Make a Monoplane Glider

By WILLIAM GROTZINGER

A simple glider of the monoplane type can be easily constructed in a small workshop; the cost of materials is not great and the building does not require skilled workmen. Select the material with care and see that the wood is straight-grained and free from knots. The following list of spruce pieces is required:

4 main wing spars, ¾ by 1¼ in. by 17 ft.
2 rudder spars, ¾ by 1 in. by 8 ft.
8 wing crosspieces, ¾ by ¾ in. by 4 ft.
4 rudder crosspieces, ½ by ½ in. by 2 ft.
1 piece for main frame crosspieces, ½ by 1 in. by 12 ft.
2 arm pieces, 1½ by 2 in. by 3½ ft.

The following list of poplar pieces is required in making the supports for the cloth covering on the wings and rudders.

34 main-wing ribs, ¼ by ¾ by 64 in.
8 rudder ribs, ¼ by ½ by 36 in.
5 rudder ribs, ¼ by ¾ by 48 in.

The following list of oak pieces is needed:

1 piece, ⅝ by 1¼ in. by 12 ft.
1 piece, ⅝ by 1¼ in. by 6 ft.
1 piece, ¾ by ¾ in. by 3½ ft.
2 pieces, ⅝ by 1½ in. by 5 ft.
4 pieces, ¾ by 1 by 28 in.

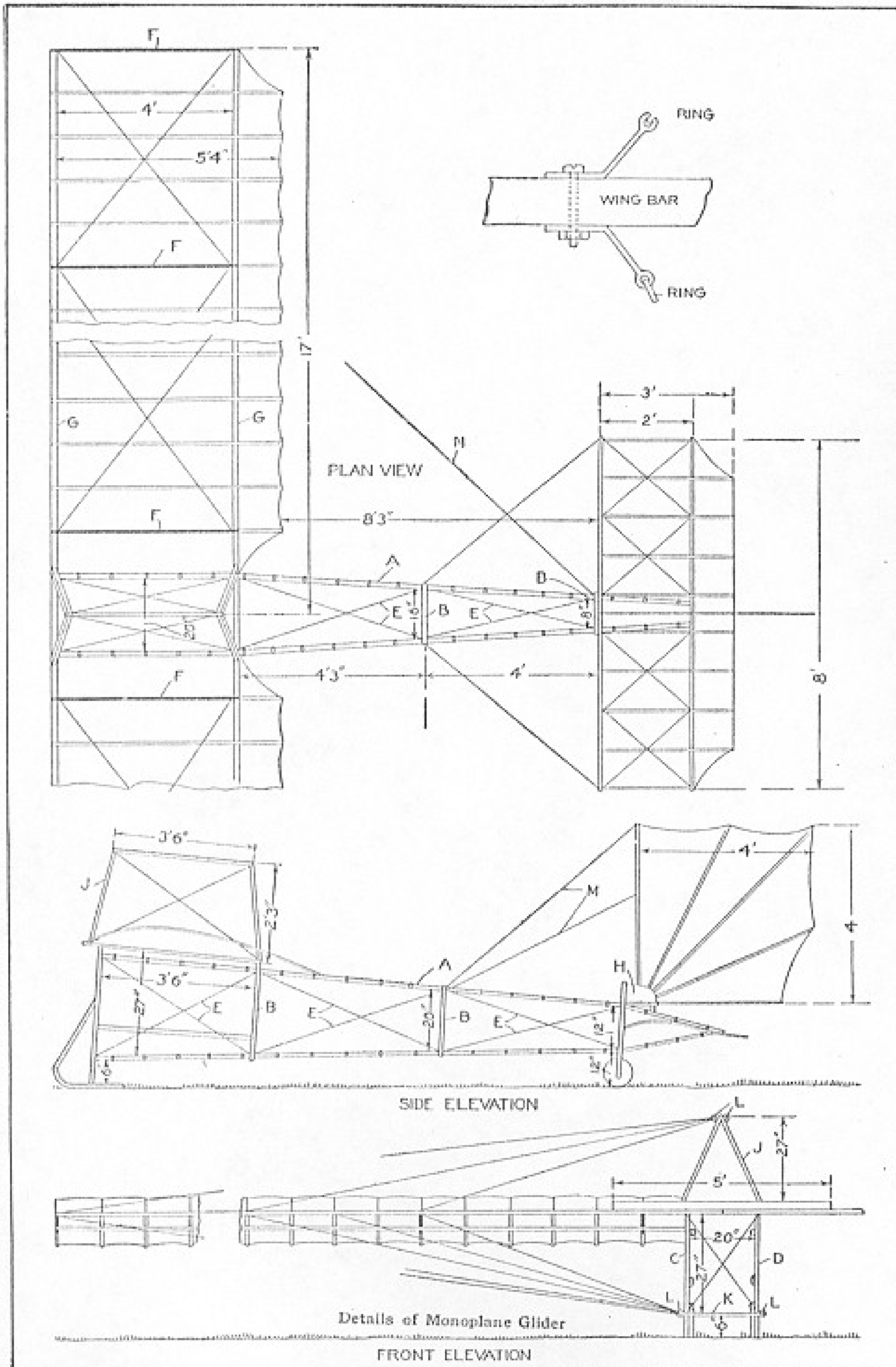
In addition to the lists given, four pieces of bamboo, 16 ft. long, tapering from 1 or 1¼ in. at the large end to ¾ in. at the small end, are used for the main frame.

Construction

The first part to make is the main frame A which is constructed of the four bamboo poles. They are made into a rectangular frame with crossbars marked B cut to the right length from the 12-ft. piece of spruce, ½ in. by 1 in. The bars C and D are of oak cut from the 6-ft. piece, ⅝ in. by 1¼ in. All of these crossbars are fastened together in rectangular form by means of stove bolts. The bamboo poles are then bolted to the inner corners of the frames with $\frac{3}{16}$-in. bolts. Place the bolts through the bamboo close to a joint to prevent splitting. The frame is then rigidly trussed by diagonal wires marked E crossing all rectangles. The wire used for trussing all the parts throughout the glider is piano wire, 16 gauge. The arm pieces are bolted to the sides of the rectangular frames beneath the wings.

The framework of the main wings or planes should be put together by bolting the cross struts F at regular intervals on the under side of the main spars G. Brace the frame diagonally with the piano wire. The ribs are nailed to the main spars by using 1-in. brads. The ribs are spaced 1 ft. apart, and curved so that the highest part will be 5 in. from the horizontal. Each rib extends 15 in. back of the rear spar. The rudder is made in the same manner.

The vertical rudder is made to fold. A small pocket arrangement H is made



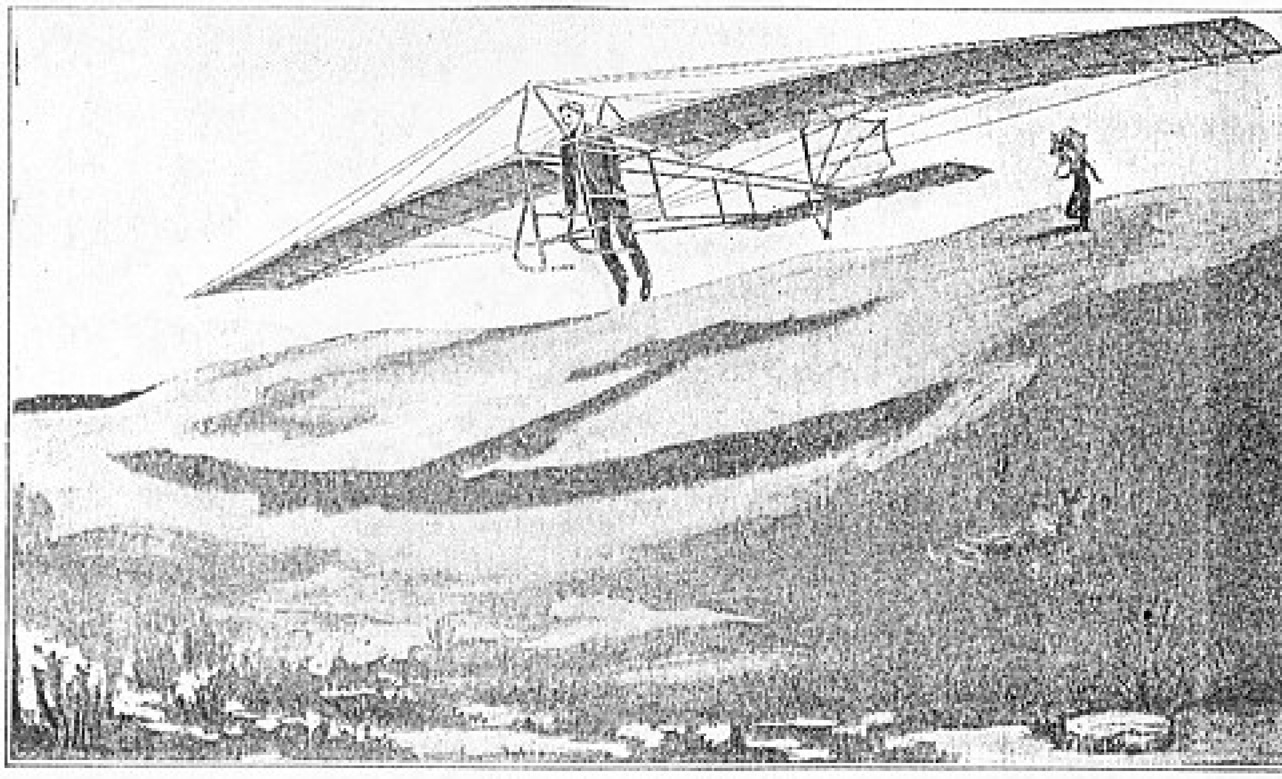
Details of Monoplane Glider

from which the rigs of the vertical rudder diverge.

The covering of the wings and rudders should be a good quality of muslin or some light aeronautical goods. The cloth should be tacked to the front spar, to the ribs, and then sewn to a wire which connects the ends of the ribs.

Construct the triangular arrangement marked J to which the wings are braced. The wing bar supports are shown in the illustration. The bottom wires are braced to the crossbar K shown in the front elevation.

The bracing wires are all fastened to a snaphook which can be snapped into the rings at the places marked L. This method will allow one quickly to assemble or take apart the plane and store it in a small place. The vertical rudder should be braced from each rib to the front spar of the horizontal rudder and then braced by the wires M to hold the rudder from falling back. The rudder is then braced to the main frame and the main frame is braced by the wires N to the wings. This will hold the plane rigid. Use snaphooks and eyebolts wherever possible so that the plane can be quickly assembled.



Monoplane Glider in Flight

Assembling

The triangular arrangement J is bolted to the wings and the top wires put in place. The wings are then put on the main frame and bolted to the bars marked C and D, after which the bottom wires are fixed in place.

Gliding

Take the glider to the top of a hill, step into the center of the main frame just a little back of the center of the wings. Put your arms around the arm pieces, face the wind and run a few steps. You will be lifted off the ground and carried down the slope. The balancing is done by shifting the legs. The glides should be short at first, but by daily practice, and, as the operator gains skill, glides can be made up to a length of several hundred feet. Do not attempt to fly in a wind having a velocity of more than 15 miles an hour.

Popular Mechanics — 1915

How to Build a Skiff

The following is a description of an easily constructed 12-ft. skiff, suitable for rowing and paddling. This is the type used by many duck hunters, as it may be easily pushed through marshes. It is constructed of ¾-in. dressed pine, or cypress.

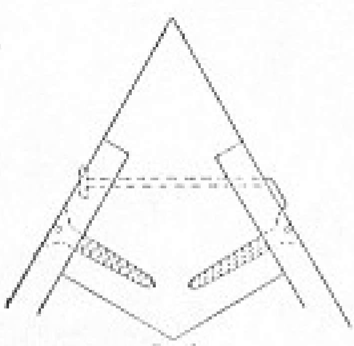


Fig. 1

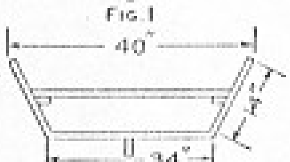


Fig. 2

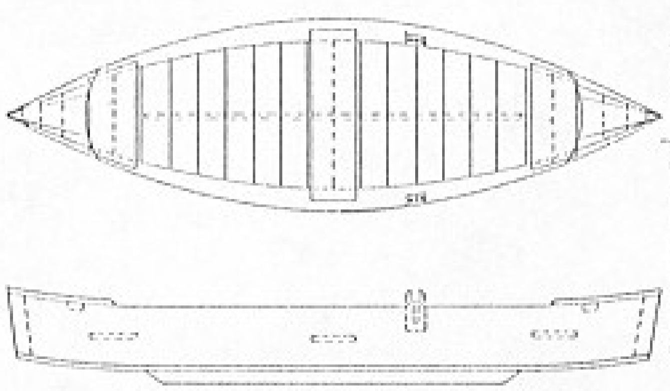


Fig. 3

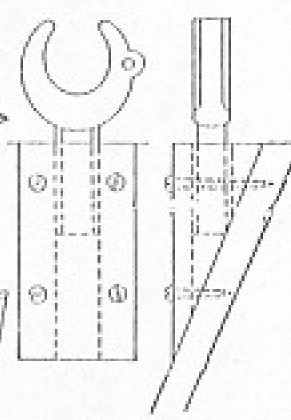


Fig. 4

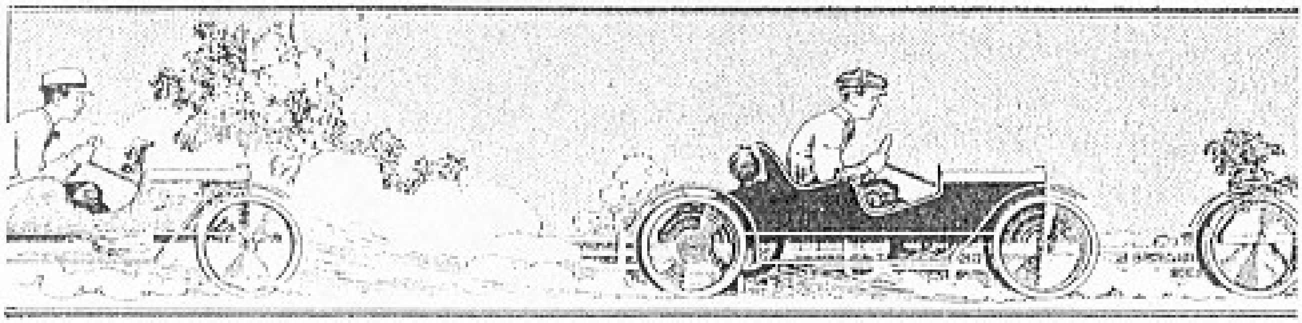
The Skiff is Especially Constructed for Use in Shallow Water and Marshes by Duck Hunters, but with the Addition of a Keel It Makes a Good Craft for Almost Any Water as a Rowboat

The sides consist of planks, 14 in. wide, but 12-in. planks may be used, the length being 12 ft. 4 in. Two stem pieces are constructed as shown in Fig. 1, and the plank ends are fastened to them with screws. Nail a crosspiece on the plank edges in the exact center, so as to space the planks 34 in. apart, as shown in Fig. 2; then turn it over and nail another crosspiece in the center of the planks for width, and make the spacing of the other edges 40 in. Plane the lower edges so that, in placing a board across them, the surfaces will be level. The floor boards are 6 in. wide and fastened on crosswise, being careful to apply plenty of red lead between all joints and using galvanized nails, 2 in. long.

A deck, 18 in. long, is fastened on each end, as shown in Fig. 3. It is made of strips fastened to a crosspiece. The seats, or thwarts, consist of 10-in. boards, and are placed on short strips fastened to the side planks about 5 in. from the bottom. The oarlocks are held in a wedge-shaped piece of wood, having a piece of gas pipe in them for a bushing, the whole being fastened at the upper edge of the side planks with screws, as shown in Fig. 4. The location of these must be determined by the builder.

Some calking may be required between the bottom, or floor, boards, if they are not nailed tightly against one another. The calking material may be loosely woven cotton cord, which is well forced into the seams. The first coat of paint should be of red lead mixed with raw linseed oil, and when dry any color may be applied for the second coat.

While, for use in shallow water, these boats are not built with a keel, one can be attached to prevent the boat from "sliding off" in a side wind or when turning around. When one is attached, it should be ¾ in. thick, 3 in. wide, and about 8 ft. long.—Contributed by B. Francis Dashiell, Baltimore, Md.



How to Make a Flymobile

Popular Mechanics — 1915

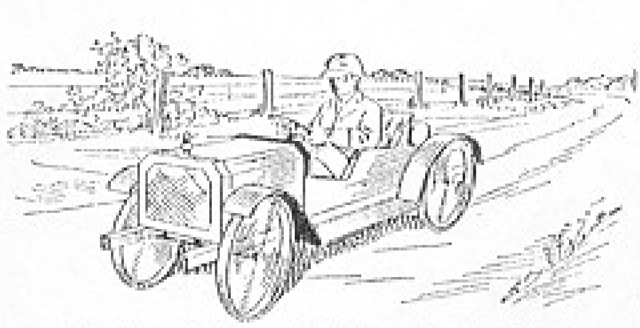
By EDWARD SIEJA

The boy owning a pushmobile, or even a power-driven auto car, is often very much disappointed because motion soon stops when the power is not applied. The car illustrated is of a little different type, being equipped with a flywheel that will propel the car and carry the rider a considerable distance after stopping the pedaling. The flywheel also aids the operator, as it will steady the motion and help him over a rough place or a bump in the road.

The main frame of the flymobile is made up of a few pieces of 2 by 4-in. timbers. The pieces A are 6 ft. 4 in. long, and the end crosspieces B, 24 in. long. These are jointed, glued and screwed together, as shown in Fig. 1. The frame that supports the driving parts consists of a piece, C, 6 ft. 2 in. long, and a piece D, 2 ft. 11 in. long. These are fitted in the main frame and securely fastened to the end crosspieces B. Two other crosspieces, E and F, are used to strengthen the driving-parts frame.

The entire hanger G, with its bearings, cranks and pedals, can be procured from a discarded bicycle and fastened to the piece C; the barrel holding the bearings being snugly fitted into a hole bored in the piece with an expansive bit. The location will depend on the builder and should be marked as follows: Place the hanger on top of the piece C, then put a box or board on the frame where the seat is to be and set the hanger where it will be in a comfortable position for pedaling. Mark this location and bore the hole.

The transmission H consists of a



The Flymobile is a Miniature Automobile in Appearance and is Propelled by Foot Power

bicycle coaster-brake hub, shown in detail in Fig. 2. A split pulley, J, 6 in. in diameter, is bored out to fit over the center of the hub between the spoke flanges. The halves of the pulley are then clamped on the hub with two bolts, run through the holes in opposite directions. Their heads and nuts are let into countersunk holes so that no part will extend above the surface of the pulley. The supports for the hub axle consist of two pieces of bar iron, 4 in. long, drilled to admit the axle ends, and screws for fastening them to the frame pieces C and D. This construction is clearly shown in Fig. 2.

The arrangement of the coaster-brake hub produces the same effect as a coaster brake on a bicycle. The one propelling the flymobile may stop the foot-power work without interfering with the travel of the machine, and, besides, a little back pressure on the pedals will apply the brake in the same manner.

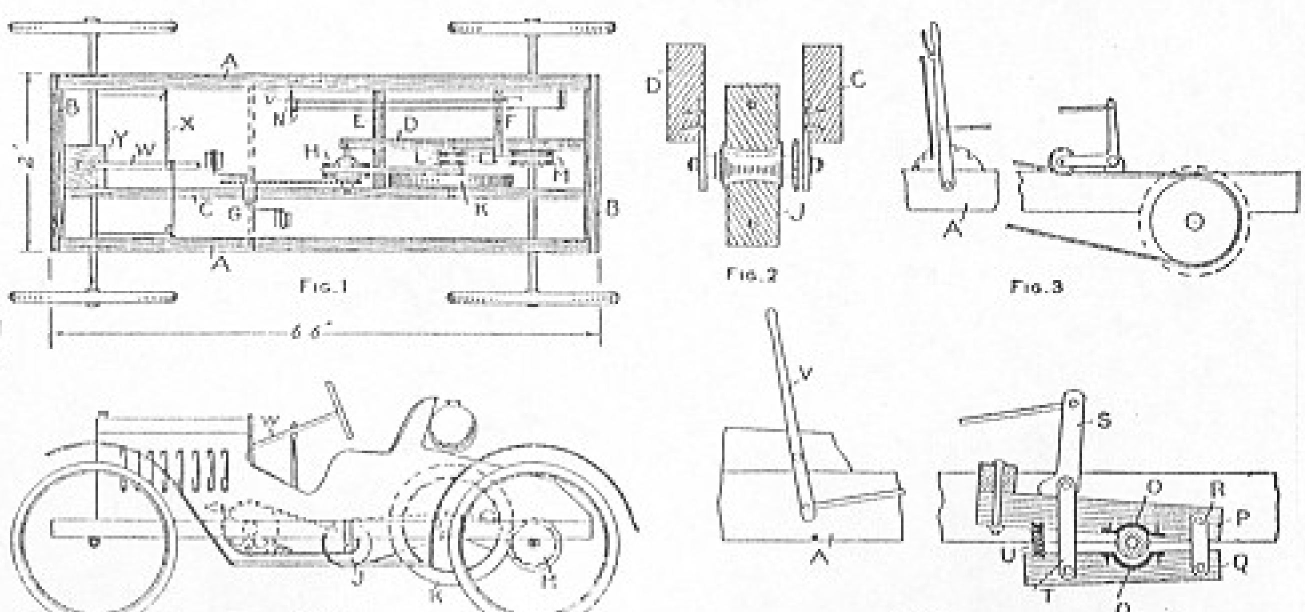
The flywheel K should be about 18 in. in diameter with a 2-in. rim, or face. Such a wheel can be purchased cheaply from any junk dealer. The flywheel is set on a shaft, turning between the pieces C and D and back of the coaster-brake wheel H. Two pulleys, L, about 3 in. in diameter, are fastened to turn with the flywheel on the shaft and are fitted with flanges to separate the belts. The ends of the shaft should run in good bearings, well oiled.

Another pulley, M, 6 in. in diameter, is made of wood and fastened to the rear axle. An idler wheel, shown in Fig. 3, is constructed of a small pulley, or a large spool, attached to an L-shaped piece of metal, which in turn is fastened on the end of a shaft controlled by the lever N. The function of this idler is to tighten up the belt or release it, thus changing the speed in the same manner as on a motorcycle.

The elevation of the flymobile is given in Fig. 4, which shows the arrangement of the belting. The size of the pulleys on the flywheel shaft causes it to turn rapidly, and, for this reason, the weight of the wheel will run the car a considerable distance when the coaster hub is released.

The rear axle revolves in bearings, half of which is recessed in the under edges of the pieces A while the other half is fastened to a block, screwed on over the axle. A simple brake is made as shown in Fig. 5. Two metal pieces, O, preferably brass, are shaped to fit over the shaft with extending ends for fastening them to the pieces P and Q, as shown. These pieces are hinged with strap iron, R, at one end, the other end of the piece P being fastened to the crosspiece F, Fig. 1, of the main frame. The lower piece Q is worked by the lever S and side bars, T. A small spring, U, keeps the ends of the pieces apart and allows the free turning of the axle until the brake lever is drawn. The lever S is connected by a long bar to the hand lever V.

The steering apparatus W, Figs. 1 and 4, is constructed of a piece of gas pipe, 3 ft. 4 in. long, with a wheel at one end and a cord, X, at the other. The center part of the cord is wound several times around the pipe and the



Plan and Elevation of the Flymobile, Showing the Location of the Working Parts, to Which, with a Few Changes, a Motorcycle Engine can be Attached to Make It a Cyclecar; Also Details of the Brakes, Belt Tightener and Coaster-Brake Hub

ends are passed through screweyes in the main frame pieces A and attached to the front axle, which is pivoted in the center under the block Y. The lower end of the pipe turns in a hole bored slanting in the block. A turn of the steering wheel causes one end of the cord to wind and the other to unwind, which turns the axle on the center pivot.

The wheels are bicycle wheels, and the ends of the front axle are turned to receive the cones and nuts, instead of using the regular hub axles. The ends of the rear axle are turned to closely fit the hubs after the ball cups have been removed. A large washer and nut clamp each wheel to the axle so that it will turn with it.

The body can be made up as desired, from sheet metal, wood, or cloth stretched over ribs of wood, and painted in the manner of an automobile. A tank and tires can be placed on the back to add to the appearance. Fenders and a running board can be attached to the main frame.

With the addition of some crosspieces in the main frame at the front and a motorcycle engine fastened to them so that the driving sprocket will be in line with the sprocket on the coaster hub, the builder will have a real cyclecar.

Popular Mechanics — 1913

How to Make a Lathe

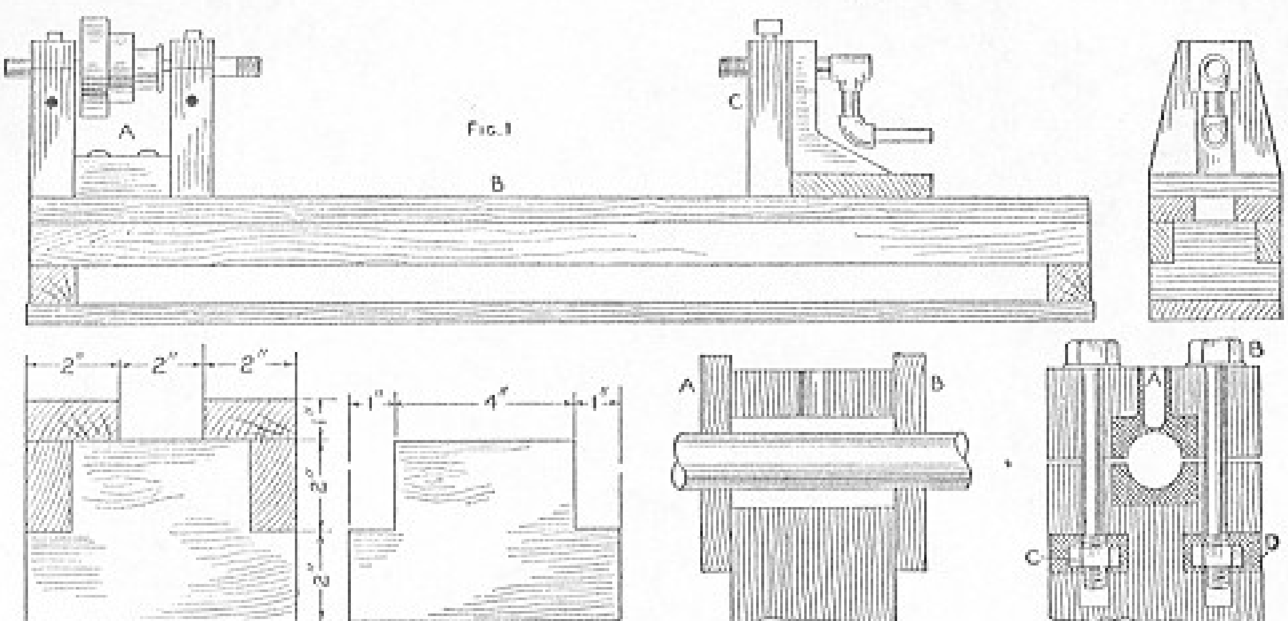
A small speed-lathe, suitable for turning wood or small metal articles, may be easily made at very little expense. A lathe of this kind is shown in the cut (Fig. 1), where A is the headstock, B the bed and C the tailstock. I run my lathe by power, using an electric motor and countershaft, but it could be run by footpower if desired. A large cone pulley would then be required, but this may be made in the same manner as the small one, which will be described later.

The bed of the machine is made of wood as shown in Figs. 2 and 3, hardwood being preferable for this purpose. Fig. 2 shows an end view of the assembled bed, and Fig. 3 shows how the ends are cut out to receive the side pieces.

The headstock, Fig. 6, is fastened to the bed by means of carriage bolts, A, which pass through a piece of wood, B, on the under side of the bed. The shaft is made of ¾-in. steel tubing about ⅛ in. thick, and runs in babbitt bearings, one of which is shown in Fig. 5.

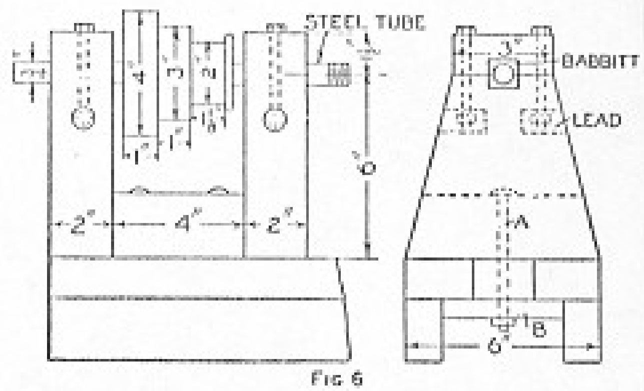
To make these bearings, cut a square hole in the wood as shown, making half of the square in each half of the bearing. Separate the two halves of the bearing slightly by placing a piece of cardboard on each side, just touching the shaft. The edges which touch the shaft should be notched like the teeth of a saw, so as to allow the babbitt to run into the lower half of the bearing. The notches for this purpose may be about ⅛ in. pitch and ⅛ in. deep. Place pieces of wood against the ends of the bearing as shown at A and B, Fig. 4, and drill a hole in the top of the bearing as shown in Fig. 4.

The bearing is then ready to be poured. Heat the babbitt well, but not hot enough to burn it, and it is well to have the shaft hot, too, so that the babbitt will not be chilled when it strikes the shaft. If the shaft is thoroughly chalked or smoked the babbitt will not stick to it. After pouring, remove the shaft and split the bearing with a round, tapered wooden pin. If the bearing has been properly made, it will split along the line of the notched cardboard where the section of the metal is smallest. Then drill a hole in the top as shown at A, Fig. 5, drilling just deep enough to have the point of the drill appear at the lower side. This cavity acts as an oil cup and prevents the bearing from running dry.



Assembled Lathe Bed and Bearing Details

The bolts B (Fig. 5) are passed through holes in the wood and screwed into nuts C, which are let into holes

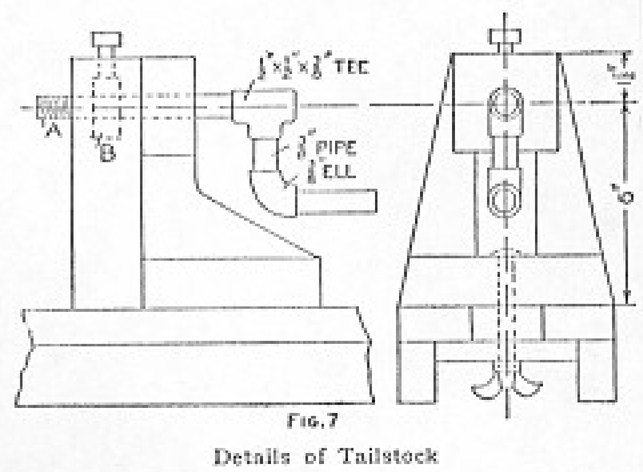


Headstock Details

D, the holes afterward being filled with melted lead.

This type of bearing will be found very satisfactory and may be used to advantage on other machines. After the bearings are completed the cone pulley can be placed on the shaft. To make this pulley cut three circular pieces of wood to the dimensions given in Fig. 6 and fasten these together with nails and glue. If not perfectly true, they may be turned up after assembling, by rigging up a temporary toolrest in front of the headstock.

The tailstock (Fig. 7) is fastened to the bed in the same manner as the headstock, except that thumb nuts are used on the carriage bolts, thus allowing the tailstock to be shifted when necessary. The mechanism of the center holder is obtained by using a ½-in.



Details of Tailstock

pipe, A, and a ½-in. lock nut, B, embedded in the wood.

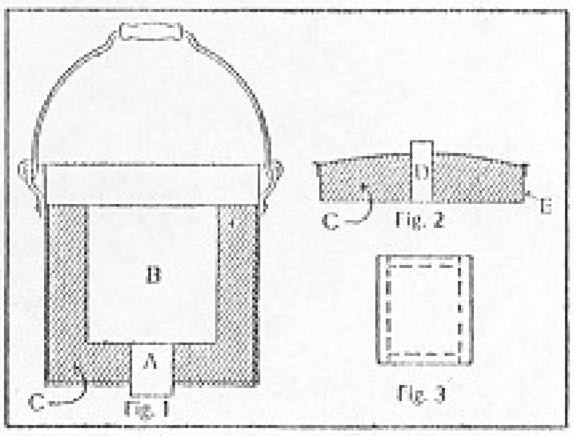
I found that a wooden tool-rest was not satisfactory, so I had to buy one, but they are inexpensive and much handier than homemade tool rest.—Contributed by Donald Reeves, Oak Park, Ill.

Popular Mechanics — 1913

Homemade Pottery Kiln

A small kiln for baking clay figures may be built at a cost of $1. The following shows the general plan of such a kiln which has stood the test of 200 firings, and which is good for any work requiring less than 1400° C.

Get an iron pail about 1 ft. high by 1 ft. across, with a cover. Any old pail which is thick enough will do, while a new one will cost about 80 cents. In the bottom of this cut a 2-in. round hole and close it with a cork or wood plug, A, Fig. 1, which shall project at least 2 in. inside the pail. Make a cylindrical core of wood, B, Fig. 1, 8 in. long and 8 in. across. Make a



Homemade Pottery Kiln

mixture of clay, 60%; sand, 15%; and graphite, 25%, kneading thoroughly in water to a good molding consistency. Line the pail, bottom and sides, with heavy paper and cover the core with same. Now pack the bottom of the pail thoroughly with a 2-in. layer of the clay mixture, and on it set the paper-wrapped core, carefully centering it. The 2 in. of space between the core and the sides of the pail all around is to be filled with clay, C, as is shown in the sketch, using a little at a time and packing it very tight. In like manner make the cover of the kiln, cutting the hole a little smaller, about 1 in. At the edge or rim of the cover encircle a 2-in. strip of sheet iron, E, Fig. 2, to hold the clay mixture, C. Set aside for a few days until well dried.

While these are drying you may be making a muffle, if there is to be any glazing done. This is a clay cylinder (Fig. 3) with false top and bottom, in which the pottery to be glazed is protected from any smoke or dust. It is placed inside the kiln, setting on any convenient blocks which will place it midway. The walls of the muffle should be about ½ in. thick, and the dimensions should allow at least 1 in. of space all around for the passage of heat between it and the walls of the kiln. By the time the clay of the kiln is well dried, it will be found that it has all shrunk away from the iron about ⅜ in. After removing all the paper, pack this space—top, bottom and sides—with moist ground asbestos. If the cover of the pail has no rim, it may be fastened to the asbestos and clay lining by punching a few holes, passing wire nails through and clinching them. Fit all the parts together snugly, take out the plugs in the top and bottom, and your kiln is ready for business. The handle of the pail will be convenient for moving it about, and it can be set on three bricks or some more elaborate support, as dictated by fancy and expense.

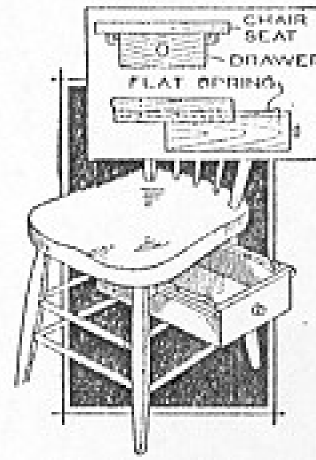
The temperature required for baking earthenware is 1250°-1310°, C.; hotel china, 1330°; hard porcelain, 1390°-1410°. These temperatures can not be obtained in the above kiln by means of the ordinary Bunsen burner. It will be necessary either to buy the largest size Bunsen, or make one yourself, if you have the materials. If you can get a cone which can be screwed into an inch pipe, file the opening of the cone to $\frac{1}{16}$ in. diameter, and jacket the whole with a 2½-in. pipe. The flame end of this burner tube should be about 4½ in. above the cone opening and should be covered with gauze to prevent flame from snapping back. When lighted, the point of the blue flame, which is the hottest part, should be just in the hole in the bottom of the kiln. Such a burner will be cheaply made and will furnish a kiln temperature of 1400°, but it will burn a great deal of gas.

A plumber's torch of medium size will cost more in the beginning, but will be cheaper in operation. Whatever burner is used, the firing should be gradual, and with especial caution the first time. By experiment you will find that a higher temperature is obtained by placing a 1-in. pipe 2 ft. long over the lid hole as a chimney. It would be still more effective to get another iron pail, 2 in. wider than the kiln, and get a down draft by inverting it over the kiln at whatever height proves most suitable.

Popular Mechanics — 1919

Convenient Tool Drawer under Chair Seat

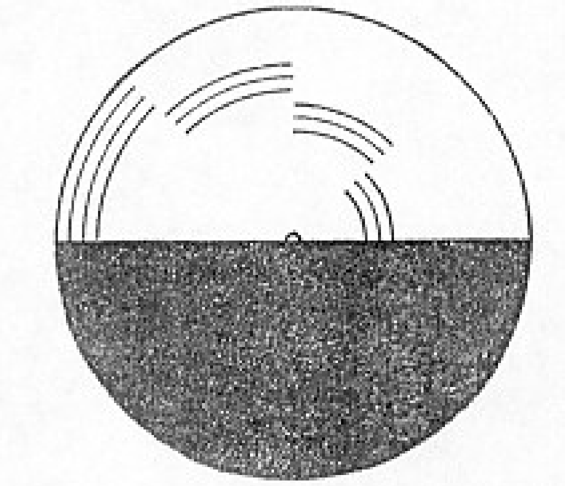
For the householder who does small repairing occasionally at home, a sliding drawer under his working chair will be found a convenience. The tools are always handy when he sits down to his work, and he can put them away again without arising from the chair. This arrangement is also useful in small shops where a chair or stool is used for tinkering and light bench work.



Popular Mechanics — 1913

An Optical Top

One of the latest optical delusions, and one not easy to explain, is Benham's color top. Cut out the black and white disk shown in the figure, and paste on a piece of stiff cardboard. Trim the edges of the cardboard to match the shape of the disk, and make a pinhole in the center. Cut the pin in half and push it through from the under side until the head of the pin touches the cardboard. Spin slowly in a strong light and some of the lines will appear colored. The colors appear different to different people, and are changed by reversing the rotation.



An Optical Top

Laying Out a Horizontal Sundial Plate

Popular Mechanics — 1919

To make a sundial accurately it is necessary to lay out the lines for the particular locality where it is to be used, as a dial will vary slightly according to the latitude. The parts may be made of wood, metal, or stone. A good method is to have a bronze casting made from a wooden pattern. The lines may be cut with a lathe and planer in a machine shop, or engraved by hand.

The illustrations show how the dial is made. The lines, as indicated in Fig. 1, should be laid out very carefully, first on a pattern. Draw a horizontal line near the top which represents the six-o'clock line, A-VI, in Fig. 2. Then lay out another line AH, at right angles to A-VI. Take a point C at any convenient place and construct the right-angled triangle ABD. The angle CAB should be equal to the degree of

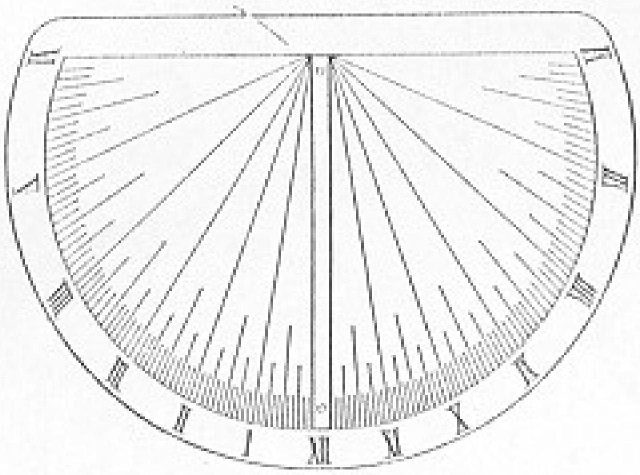
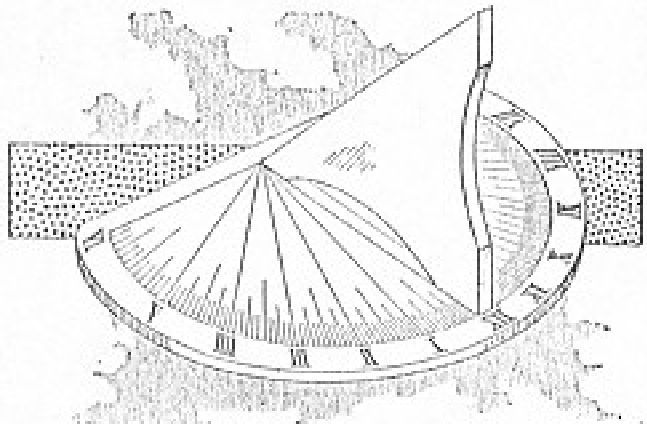


Fig.1

Lay Out the Dial Plate Symmetrically, Allowing Space for the Style

latitude of the place. The angle CBD equals CAB. Take a compass and set it to a radius equal to the side BD, and draw the quadrant DF from E. From D draw the line DG out for same distance and parallel with A-VI. Now divide the quadrant DF into six equal parts. Draw the lines E1, E2, E3, etc., and where they intersect the line DG, draw the lines from A, as A-I, A-II, A-III, etc. These are the hour lines. Divide each of the six divisions of the quadrant into four parts, and draw the lines, as shown between the 3 and 4 divisions. These are the 15-minute parts. Each of these parts may be divided in turn, and this is best done by eye, unless the dial is quite large.

This will complete one-half of the dial. The other half is done in the same manner, leaving a space between the line AH and its corresponding line for the other side of the dial. This space should be equal to the thickness of the upright shadow-casting piece, or style. The style has its base equal in length to the line AH, and its angle, S, equal to the latitude, or the angle CAB.



The Dial is Mounted Horizontally with the High End of the Style toward the North

It is mounted in the space with the high end at 12 o'clock. It may be fastened to the dial with screws passing through the base. Mount the dial horizontally on a suitable pedestal. The style should be exactly north and south, with 12 o'clock toward the north. The dial will be fast or slow over clock time. This is corrected by consulting

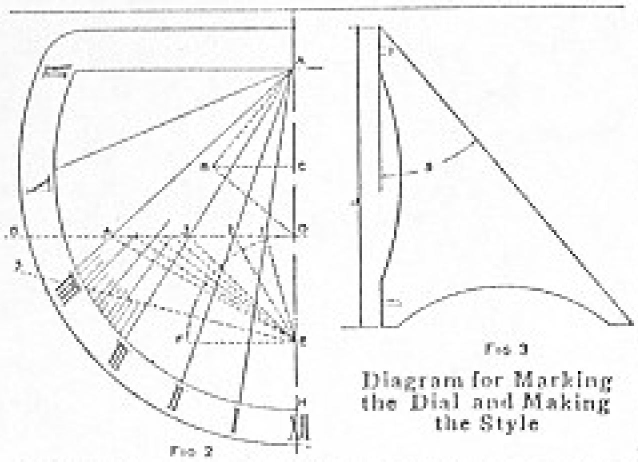


Fig 2

Fig 3

Diagram for Marking the Dial and Making the Style

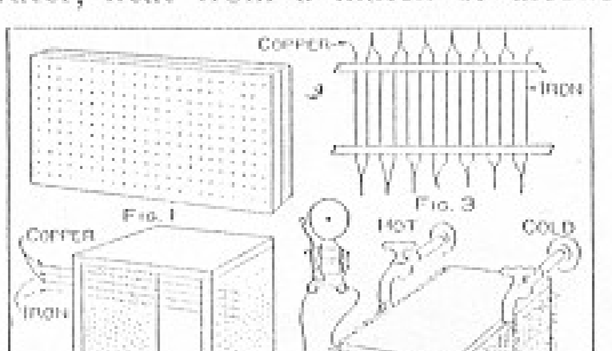
an almanac and setting the clock accordingly from the dial. A correction plate may thus be made and mounted on the pedestal.—F. B. Walters, Baltimore, Md.

Popular Mechanic — 1918

How to Make a Thermoelectric Battery

By ARTHUR E. JOERIN

A novel way of producing an electric current by means of hot and cold water, heat from a match or alcohol



Details of Battery

lamp, is obtained from a device constructed as shown in the sketch. Take two hardwood boards, marble, or slate plates, about 8 or 10 in. long, place them together, as in Fig. 1, and mark and drill about 500 holes. These two pieces should be separated about 8 in. and fastened with boards across the ends, as shown in Fig. 2.

Take soft copper wire, not smaller than No. 18 gauge, and cut in lengths to pass through the holes in the two boards, leaving sufficient end to make a tie. It will require about 70 ft. of wire to fill one-half the number of holes. Also, cut the same number of lengths from the same gauge galvanized-iron wire to fill the remaining holes. The wires are put through the holes in the boards alternately, that is: begin with copper, the next hole with iron, the next copper, the next iron, and so on, twisting the ends together as shown in Fig. 3. The connections, when complete, should be copper for the first and iron for the last wire.

When the whole apparatus is thus strung, the connections, which must be twisted, can be soldered. Connect one copper wire to the bell and the other terminal, which must be an iron wire, to the other post of the bell. The apparatus is then short-circuited, yet there is no current in the instrument until a lighted match, or, better still, the flame of an alcohol lamp is placed at one end only.

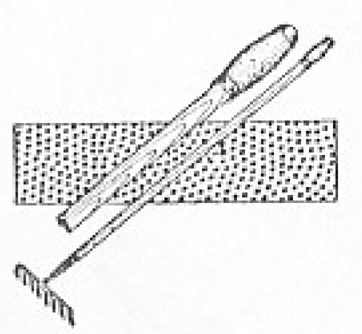
Best results are obtained by putting ice or cold water on one side and a flame on the other. The experimenter may also place the whole apparatus under sink faucets with the hot water turned on at one terminal and the cold water at the other. The greater the difference of temperature in the two terminals, the more current will be obtained.

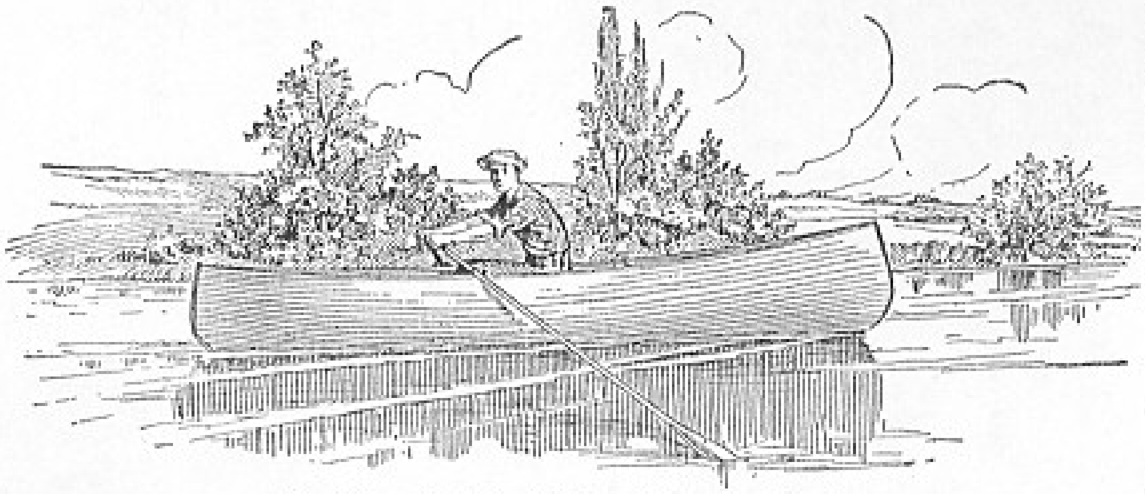
Very interesting experiments may thus be performed, and these may lead to the solving of the great thermoelectric problem.

Bicycle-Handle Grip on Rake Handle

Popular Mechanics — 1919

By fitting a bicycle handle to the end of a rake handle a grip is provided that is comfortable in the hand when considerable raking is to be done. The sketch shows the grip attached. Several small brads were nailed through the handle and countersunk so as not to injure the hand. This prevented the grip from becoming loosened easily.



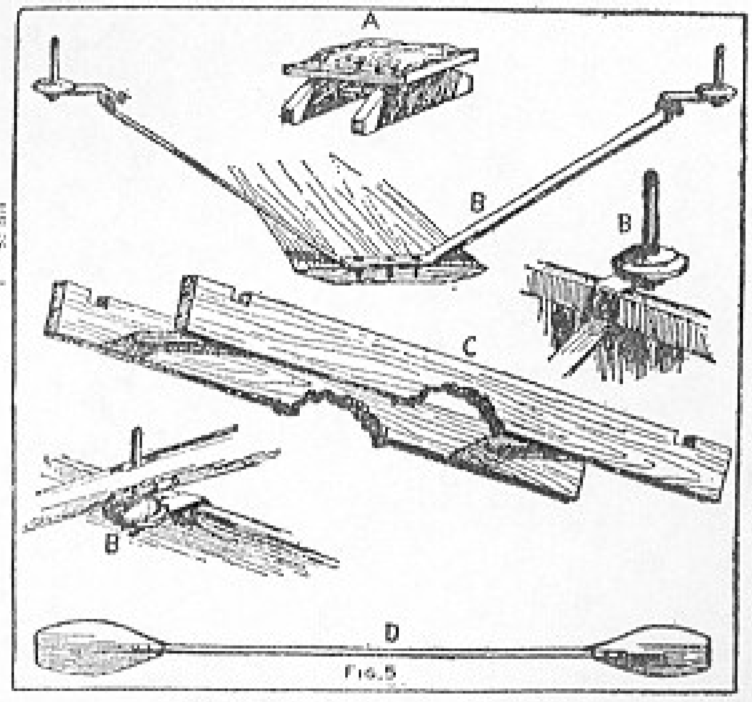


The Paper Boat Is Light and Easy to Propel

Popular Mechanic 1913

HOW TO MAKE A PAPER BOAT

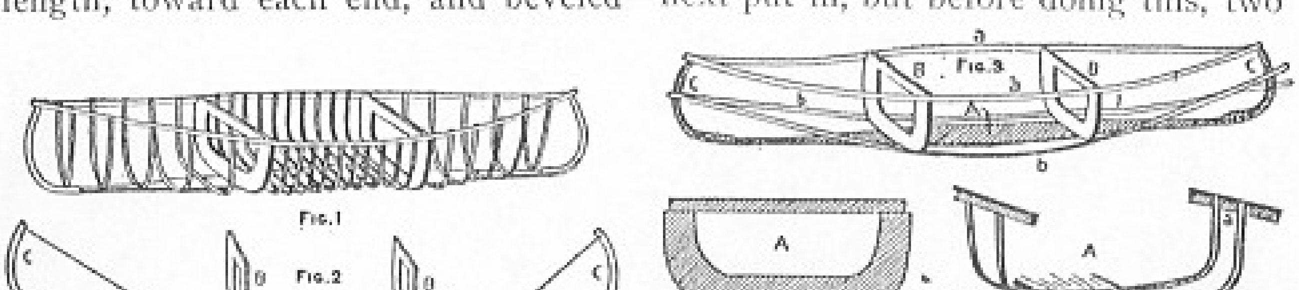
A Light Boat That Can Be Easily Carried



Important Features of Construction

Now you might think it absurd to advise making a paper boat, but it is not, and you will find it in some respects and for some purposes better than the wooden boat. When it is completed you will have a canoe, probably equal to the Indian's bark canoe. Not only will it serve as an ideal fishing boat, but when you want to combine hunting and fishing you can put your boat on your shoulders and carry it from place to place wherever you want to go and at the same time carry your gun in your hand. The material used in its construction is inexpensive and can be purchased for a few dollars.

Make a frame (Fig. 1) on which to stretch the paper. A board 1 in. thick and about 1 ft. wide and 11½ ft. long is used for a keel, or backbone, and is cut tapering for about a third of its length, toward each end, and beveled on the outer edges (A, Fig. 2). The cross-boards (B, B, Fig. 2) are next sawed from a pine board 1 in. thick. Shape these as shown by A, Fig. 4, 13 in. wide by 26 in. long, and cut away in the center to avoid useless weight. Fasten them cross-wise to the bottom-board as shown in Fig. 1 and 2, with long stout screws, so as to divide the keel into three nearly equal parts. Then add the stem and stern pieces (C, C, Fig. 2). These are better, probably, when made of green elm. Screw the pieces to the bottom-board and bend them, as shown in Fig. 2, by means of a string or wire, fastened to a nail driven into the bottom. Any tough, light wood that is not easily broken when bending will do. Green wood is preferable, because it will retain the shape in which it has been bent better after drying. For the gunwales (a, a, Fig. 3), procure at a carriage factory, or other place, some light strips of ash, ⅜ in. thick. Nail them to the cross-boards and fasten to the end pieces (C, C,) in notches, by several wrappings of annealed iron wire or copper wire, as shown in Fig. 3. Copper wire is better because it is less apt to rust. For fastening the gunwales to the crossboards use nails instead of screws, because the nails are not apt to loosen and come out. The ribs, which are easily made of long, slender switches of osier willow, or similar material, are next put in, but before doing this, two strips of wood (b, b, Fig. 3) should be bent and placed as in Fig. 3. They are used only temporarily as a guide in putting in the ribs, and are not fastened, the elasticity of the wood being sufficient to cause them to retain their position. The osiers may average a little more than ½ in. in thickness and should be cut, stripped of leaves and bark and put in place while green and fresh. They are attached to the bottom by means of shingle nails driven through holes previously made in them with an awl, and are then bent down until they touch the strips of ash (b, b, Fig. 3), and finally cut off even with the tops of the gunwales, and notched at the end to receive them (B, Fig. 4). Between the cross-boards the ribs are placed at intervals of 2 or 3 in., while in other parts they are as much as 5 or 6 in. apart. The ribs having all been fastened in place as described, the loose strips of ash (b, b, Fig. 3) are withdrawn and the framework will appear somewhat as in Fig. 1. In order to make all firm and to prevent the ribs from changing position, as they are apt to do, buy some split cane or rattan, such as is used for making chair-bottoms, and, after soaking it in water for a short time to render it soft and pliable, wind it tightly around the gunwales and ribs where they join, and also interweave it among the ribs in other places, winding it about them and forming an irregular network over the whole frame. Osiers probably make the best ribs, but twigs of some other trees, such as hazel or birch, will answer nearly as well. For the ribs near the middle of the boat, twigs 5 or 6 ft. long are required. It is often quite difficult to get these of sufficient thickness throughout, and so, in such cases, two twigs may be used to make one rib, fastening the butts side by side on the bottom-board, and the smaller ends to the gunwales, as before described. In drying, the rattan becomes very tight and the twigs hard and stiff.



Details of Framework Construction

The frame-work is now complete and ready to be covered. For this purpose buy about 18 yd. of very strong wrapping-paper. It should be smooth on the surface, and very tough, but neither

stiff nor very thick. Being made in long rolls, it can be obtained in almost any length desired. If the paper be 1 yd. wide, it will require about two breadths to reach around the frame in the widest part. Cut enough of the roll to cover the frame and then soak it for a few minutes in water. Then turn the frame upside down and fasten the edges of the two strips of paper to it, by lapping them carefully on the under side of the bottom-board and tacking them to it so that the paper hangs down loosely on all sides. The paper is then trimmed, lapped and doubled over as smoothly as possible at the ends of the frame, and held in place by means of small clamps. It should be drawn tight along the edges, trimmed and doubled down over the gunwale, where it is firmly held by slipping the strips of ash (b, b) just inside of the gunwales into notches which should have been cut at the ends of the cross-boards. The shrinkage caused by the drying will stretch the paper tightly over the framework. When thoroughly dry, varnish inside and out with asphaltum varnish thinned with turpentine, and as soon as that has soaked in, apply a second coat of the same varnish, but with less turpentine; and finally cover the laps or joints of the paper with pieces of muslin stuck on with thick varnish. Now remove the loose strips of ash and put on another layer of paper, fastening it along the edge of the boat by replacing the strips as before. When the paper is dry, cover the laps with muslin as was done with the first covering. Then varnish the whole outside of the boat several times until it presents a smooth shining surface. Then take some of the split rattan and, after wetting it, wind it firmly around both gunwales and inside strip, passing it through small holes punched in the paper just below the gunwale, until the inside and outside strips are bound together into one strong gunwale. Then put a piece of oil-cloth in the boat between the cross-boards, tacking it to the bottom-board. This is done to protect the bottom of the boat.

Now you may already have a canoe that is perfectly water-tight, and steady in the water, if it has been properly constructed of good material. If not, however, in a few days you may be disappointed to find that it is becoming leaky. Then the best remedy is to cover the whole boat with unbleached muslin, sewed at the ends and tacked along the gunwales. Then tighten it by shrinking and finally give it at least three coats of a mixture of varnish and paint. This will doubtless stop the leaking entirely and will add but little to either the weight or cost.

Rig the boat with wooden or iron rowlocks (B, B, Fig. 5), preferably iron, and light oars. You may put in several extra thwarts or cross-sticks, fore and aft, and make a movable seat (A, Fig. 5.) With this you will doubtless find your boat so satisfactory that you will make no more changes.

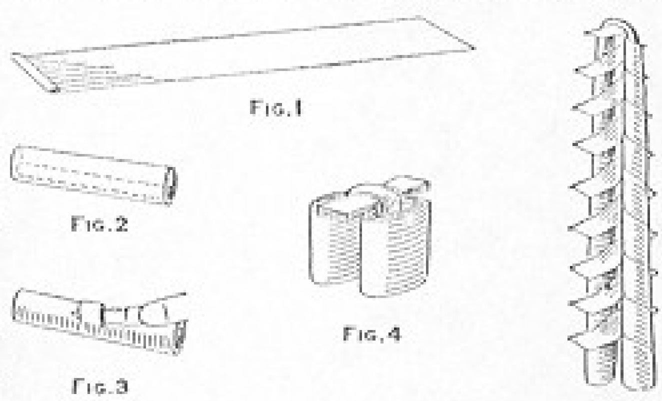
Off for a Hunt

For carrying the boat it is convenient to make a sort of short yoke (C, Fig. 5), which brings all the weight upon the shoulders, and thus lightens the labor and makes it very handy to carry.

Popular Mechanic 1915

A Chinese Pagoda

Fold the end of a long and narrow strip of paper over several times as shown in Fig. 1 and roll the entire length over a stick, then remove the roll and crease, or make it flat, as shown in Fig. 2. Make two cuts with a sharp knife centrally so that they reach to the several folds first made on the inner end of the paper, then cut the fold in the paper between the cuts as shown in Fig. 3, and bend the ends over to form the shape in Fig. 4. Insert the knife blade under the first fold and draw it out until the paper takes the form in Fig. 5.



Stages in Making the Strip of Paper into the Finished Pagoda

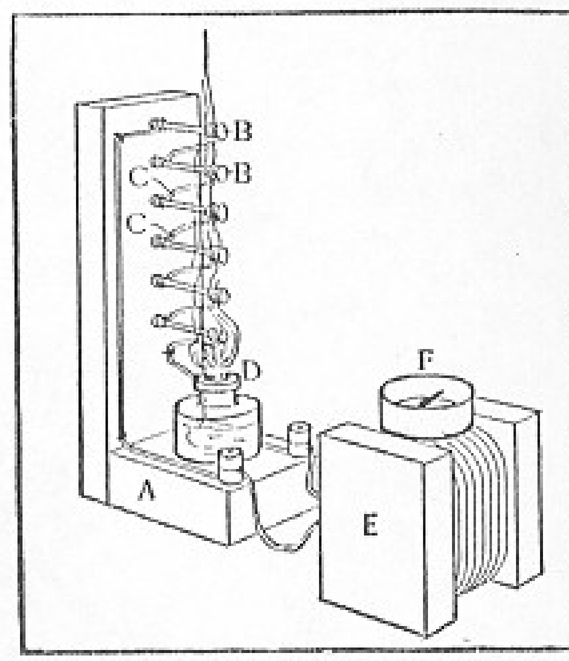
These pagodas can be made large or small, as desired, and also varied in several ways. Large ones can be formed and used as small tree ornaments. All that is necessary to make them high is to roll up one strip of paper on another in the rolling process.

In rolling up several strips, one on top of the other successively, various colored papers may be used and the appearance is greatly enhanced.

Popular Mechanics — 1913

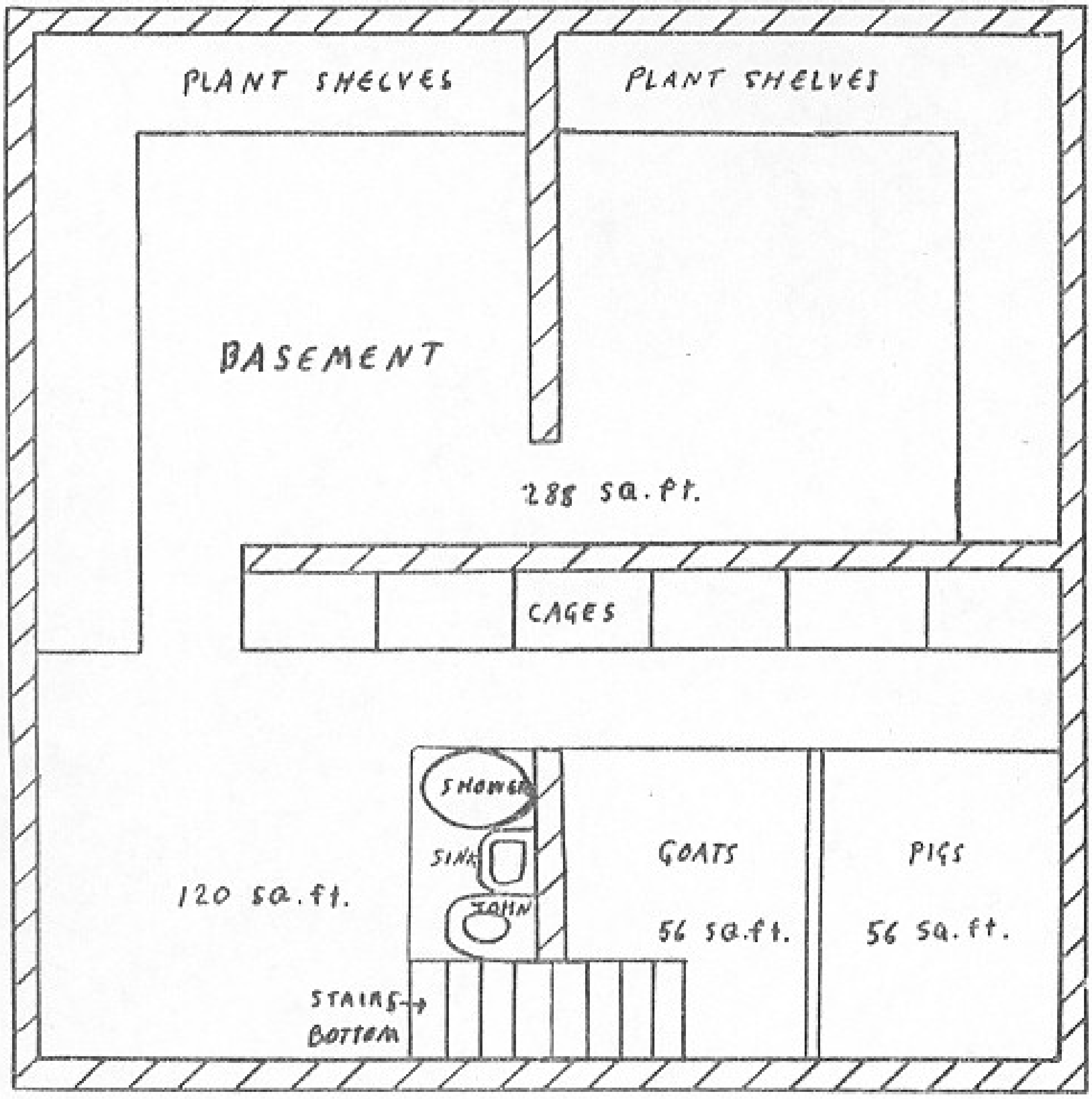
How to Make a Thermo Battery

A thermo battery, for producing electricity direct from heat, can be made of a wooden frame, A, with a number of nails, B, driven in the vertical piece and connected in series with heavy copper wires, C. The connections should all be soldered to give good results, as the voltage is very low and the resistance of an unsoldered joint would stop the current.



Thermo Battery

The heat may be supplied by an alcohol lamp or other device, and the current may then be detected by means of a simple galvanometer consisting of a square spool of No. 14 or No. 16 single-covered wire, E, with a pocket compass, F, placed on top. Turn the spool in a north and south direction, or parallel with the compass needle. Then, when the nail heads are heated and the circuit completed, the needle will swing around it at right angles to the coils of wire. Applying ice or cold water to the nail heads will reverse the current.—Contributed by A. C. A., Chicago.



THE SURVIVAL SHELTER

by Kurt Saxon

If effort and money is to be spent on a survival shelter, it should be a working part of the home. It should not be a dead area you hope will never be used.

The traditional Civil Defense two-week fallout shelter would be a death trap if it were needed. And it would be useless except for keeping a few people alive until they would be forced to come out and die.

Nuclear war, which would force Survivalists underground, would destroy society's ability to resume operations after only two weeks. Don't count on our potential destroyers to use bombs whose fallout will stop radiating after just a couple of weeks.

Besides, the devastation would wipe out crops, livestock, people, utilities, etc. Starvation would be universal. Plagues would ravage the populace for months. Those temporarily surviving the atomic attack would be crazed and desperate.

Whether or not you will actually have to go underground, you may be dependent on a self-contained life-support system for months.

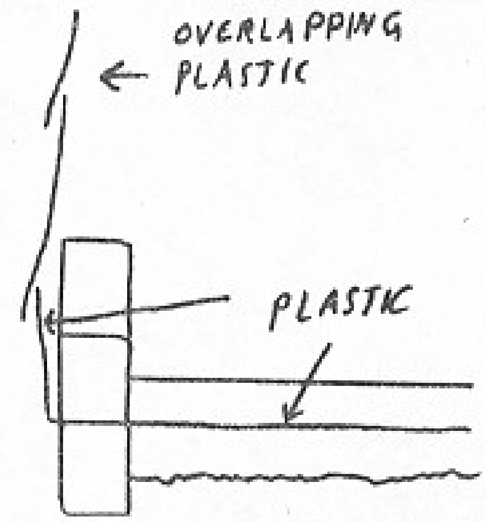
In outlining my ideas for such a life-support system, I'm going to mainly generalize. Since I'm writing for those who may start from scratch or modify their existing living quarters, hard specifications would only discourage those who could not meet them.

What follows are simply ideas. If they fit your circumstances, consider them. If they don't, then reject them. But if you consider them, prove them out for yourself, since they might not be practical for you.

In this issue I'm outlining the basement of the survival home. If you already have a basement, you can adapt it to some of these ideas.

If you are building, you can start from scratch and build this basement with no one suspecting it is to be used as a shelter. The lined part of the diagram is cinder blocks. The suggested installations can be put in after the structure is completed.

I will diagram the heating, lighting, ventilation, methane system, provisioning, etc. in future issues. The diagram describes a basement 30 x 30 feet inside and eight feet high. The floor is a layer of concrete, then a layer of black roll plastic, then another layer of concrete.



The black plastic will overlap the edges by about three feet. Around the floor will be put a layer of cinder blocks. Over the first layer will lap the plastic. Then another layer of cinder blocks will be laid on the plastic.

When the walls are up, the plastic will be pressed up and glued with tar to the outside wall. Then other layers of plastic will be glued with tar onto the outside walls, overlapping the first layers. That way, when soil is put in around the walls the plastic will make the structure completely waterproof.

When the shelter is used as a closed system, all human wastes will be recycled in the methane generator. But in the meantime, unless you are a fanatic, you may want a regular septic tank. That would be outside the diagram and would lead to the upstairs toilet.

The basement john would consist of some sort of tub for the shower, a sink and a toilet. A five-gallon bucket would be above the shower. Another such bucket, with a spigot, would be over the sink. Beneath the sink would be another bucket. The shower and sink water would be put on the plants. The contents of the toilet would be put in the methane generator.

For livestock, I'm suggesting goats because they give milk, lots of great stuff for the methane generator and are fun pets. When finally above ground, a few goats could be your ticket to high society.

You might worry about the smell of goats. Goats are very clean and odorless if allowed to be. You'd want a billy and two does and the billy would be the stinker. That's because he delights in putting his head down and peeing on his beard. This is charming to girl goats but a turnoff to people. Just clip off that beard.

Pigs would be extremely valuable. Pigs were the staple meat of the Vikings and are the most economical protein for Survivalists. If you get healthy pigs and cook the meat thoroughly, pork is perfectly safe.

Their fat would provide soap and much of your fuel. Their excrement would provide the greatest amount of methane.

I would suggest you contract with a hog raiser to sell you a couple of fine sows which are pregnant. A rutting boar down there would be useless. You could slaughter the sows as soon as their litters were weaned. Then the piglets could be gradually used up until all you had left was the healthiest young boar and a couple of young sows for future generations. You can start anytime with the livestock. No one will know.

In the middle of the diagram there are three tiers of cages. Each is 30 inches by four feet and 24 inches high.

I suggest putting rabbits in the two bottom tiers. You could start with two males and four females. The other cages will fill up in no time.

The top tier should be for chickens. You could put four layers in each cage, with a couple of roosters somewhere in there. From them you would get all the eggs you could use, plus meat and feathers. Their droppings would also give you very high quality methane.

Caring for your livestock will be detailed in future issues.

The plant shelves are three feet through and in four layers. They could be staggered to accommodate both short ˉants and tall.

This diagram is for four shelves with an overall area of 624 square feet. That will give you all the vegetation your family and livestock can handle.

All human and animal wastes and waste vegetation will be put in the methane generator. When the methane is exhausted from the wastes, they will go to feed the earthworms. Raising earthworms will also be described later. They will process the wastes and their own droppings will be put in the plant boxes. The excess worms, just oodles, will be fed to the chickens and pigs.

Next issue I will outline the above-ground structure.

The main construction will be cinder blocks. They are relatively cheap, can be worked with by amateurs, and are strong and fireproof. As the diagram shows, the cinder blocks jut out into the body of the basement and are the inner walls as well as supports. This is because there will be a lot of weight overhead and you want the strongest overall structure possible.

Before deciding on the size of your survival shelter you had better determine how many will live there. If you want to save Granny, prepare to accommodate her beforehand. Otherwise, steel yourself to keeping her out. Better to reject anyone whose life is nearly over. The future might be fun for the kids and an adventure for you, but to the elderly, adaption would probably be impossible.

Concerning neighbors, and even best friends; forget them. You might broach the idea to them to see where they stand. If they will build their own shelters or contribute to a sizeable share of yours, fine. But if they show no interest, don't give them any indication that you are preparing. If they know already, refuse to discuss your shelter unless they begin on theirs. Their only interest might be in ridiculing you and if you continue to try to sell them on the idea of building their own you're asking for trouble. For as time goes by and their chances to prepare lessen, they will stop ridiculing you and begin begging, and then threatening, for a place in your shelter. So just let them know where they stand with your shelter now, which is nowhere, and then completely drop the subject from then on.

If they are doomed, they doomed themselves. Don't ever consider sharing their doom by misguided altruism. Only those who are to be a part of the future should live to see it. Those who would insist on surviving at your expense have no part of the future.

You must not lend yourself to the survival of parasites. Nor can you afford to jeopardize your own chances by rescuing the unfortunate and the helpless. The vegetating elderly, the retarded, the criminal, the pervert, would only leave out of the future others who might have helped to make it great.

PART TWO

By Kurt Saxon

The top half of the shelter is also of cinder blocks. This is the cheapest building material, the strongest and the easiest for the layman to build.

Figure 1 shows the area made up of cinder blocks. The layout is general but the idea is to have the inside walls of cinder blocks to support the roof.

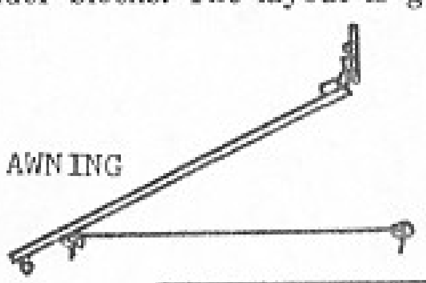
The floor should be made up of about eight inches of reinforced concrete. The roof should be of the same construction and thickness. In this way, your home will not only be a fallout shelter but also a fort.

With such a strong roof you could lay down about eight inches of soil and make a garden up there. You might slant the roof so that one side is about six inches higher than the other. A couple of outlets at the lower side will allow any excess rain to drain off the roof.

An important feature of the shelter is the awnings. They are of one-quarter inch steel. I recommend having as few windows as possible and each should be about one square yard in area.

Any metal-working shop can make the awnings. Just give them the specifications.

The part that the awning is affixed to should be a yard-long strip of the same thickness and about four inches wide. Two hinges are welded to the strip and the awning. Two holes are drilled into the strip for bolts which affix it to the cinder



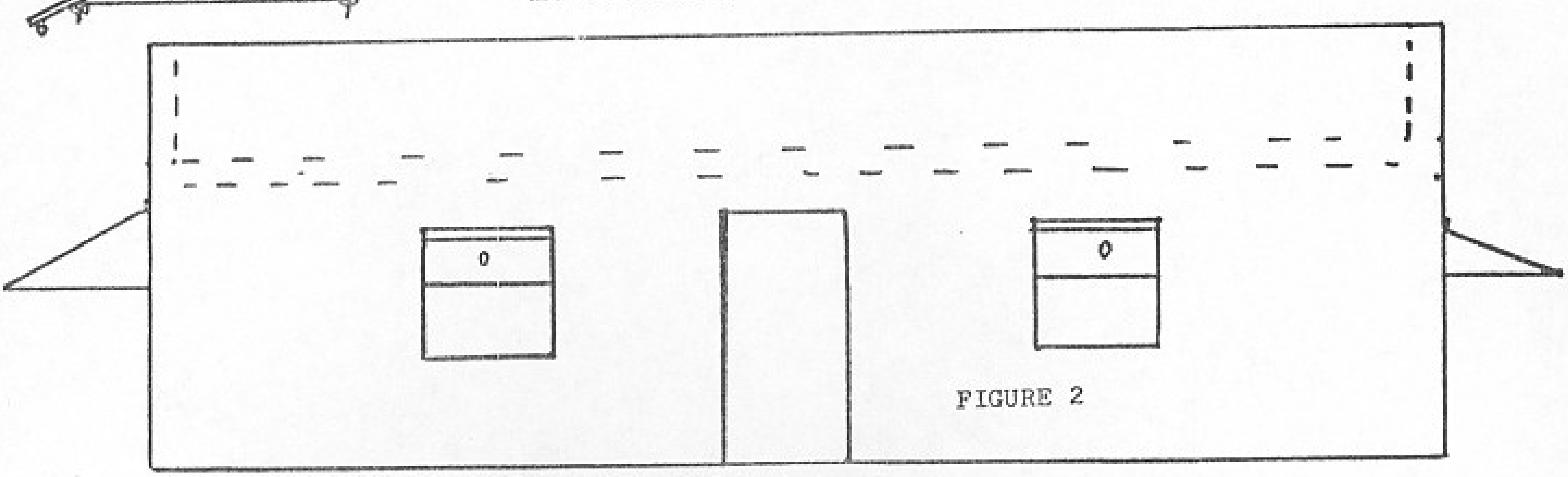


FIGURE 2

blocks.

A hole about two inches across is cut into the center of the awning. This is to shoot through. On the bottom of the awning, two eyelets are welded on. When the awning is lowered, two bolts are dropped through the eyelets into two holes drilled into the window sill.

Two more eyelets are affixed at the middle of the sides of the window. Two support rods are bent at both ends to rest in the eyelets. Two more eyelets are welded to the underside of the awning to accommodate the other ends of the rods. It should take only seconds to left the rods from the eyelets and lower the awning.

Although the awnings might seem to make your home a grim looking place, there is no reason why they can't be disguised to look like regular awnings. Wooden plugs could be glued into the gunports and the awnings could be painted prettily and no one would suspect.

To complete the fort, you might as well have quarter-inch steel doors, too. Gunports here could also be fitted with removable plugs. The doors would be covered on both sides with half-inch plywood. They would be heavy so extra strong hinges would be needed.

As I said before, all this is general. I don't expect anyone to duplicate these ideas completely. However, the general plan will give you a home secure from fallout, rioters and looters.

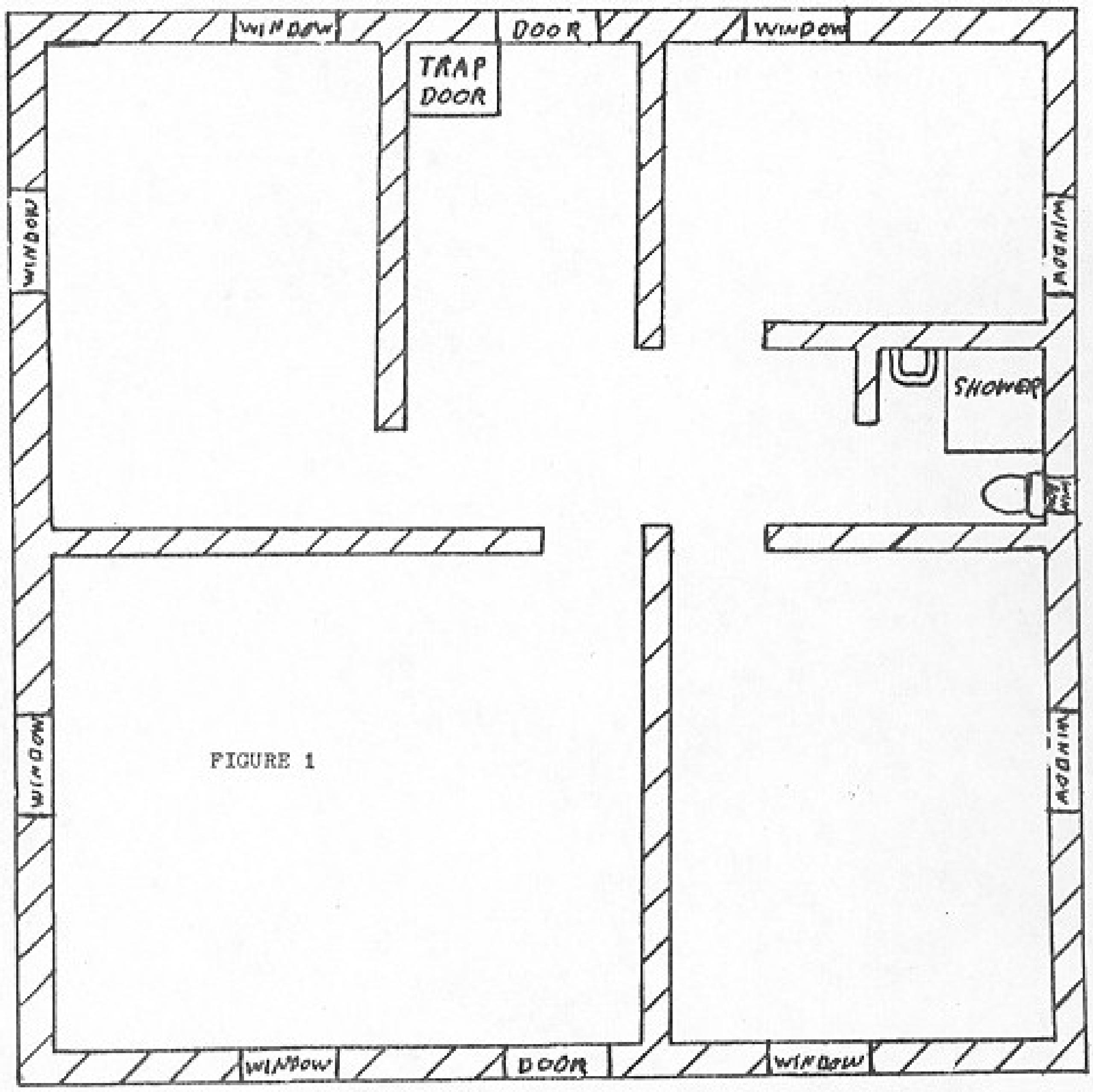


FIGURE 1

PROFITING FROM LATHEWORK

By Robert Maybeth

You can use a lathe to pay for itself in a short time. Bowls, cups, tool handles, art objects, and the like can all be made by you and sold at high profit, or kept for yourself. Lathework is easy (and fun) to learn; any normal seventh grader is capable of turning excellent work on the lathe. Even the initial outlay can be cut to a bare minimum, if you're willing to be your own toolmaker.

If you can afford a store-bought lathe, by all means get one. If not, a good home-made one is shown on page 5, volume one of THE SURVIVOR. It is as good as any store-bought lathe (and certainly better than some I've seen). It is foot-powered, but this is a minor disadvantage. The main advantage, besides cost, is that you can easily repair it yourself with your own hand made parts.

If you're not prepared to go that "primitive" yet, there are accessories on the market that turn an electric hand drill into a lathe.

Solving Your Own Energy Problems

By Kurt Saxon

This last year, Americans have seen their energy bills climb drastically. Fossil fuels will soon be too expensive to use to heat homes. The time is nearly upon us when all the sellers of energy will divert their products from the public to industry.

You will hear hints of this on TV, but only in distorted reports. Prices will rise and rise. Rolling blackouts will occur. Rationing will be imposed. By the time the diversion comes, most people will be used to reports of people dying from lack of fuel.

You might wonder why, if I'm telling the truth, Carter doesn't come out and say the same thing. You must realize that I reach very few people. Carter reaches nearly everyone. The average person coming upon my warnings, and feeling inadequate to change his lifestyle, can easily shrug me off as a nut.

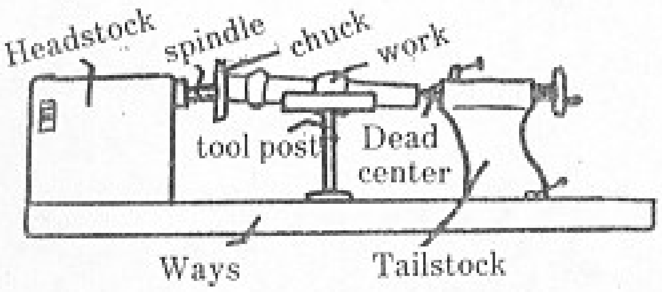
This is comfortable and a healthy thing for him, now, since he's doomed anyway. But if Carter should say what I've been saying, it couldn't be shrugged off as the ravings of some isolated nut. It would be official. There would be panic.

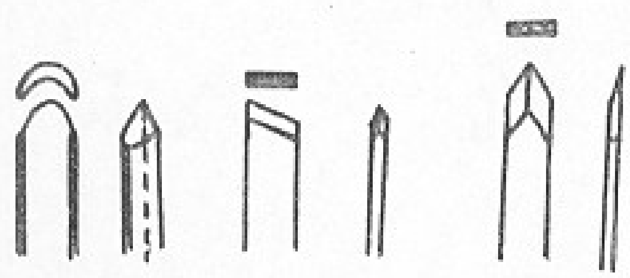
As frank as Carter is, he will never be able to admit to our huge population of inadequate losers that they are doomed. Nothing he could say to get the competent to save themselves would be worth the panic of the incompetents.

So the nitty-gritty is left to people like me to get to people like you. The incompetents will have to settle for comforting platitudes while we Survivalists stock up and batten down. Then they can riot and destroy each other with little danger to us.

Once you've realized the power companies are only a short-term energy source, you can make some realistic preparation to reduce your dependency.

A lot of lathes have expensive optional equipment, that convert the lathe into a wire wheel, jig saw, etc. You can make some of these accessories yourself, that will serve nearly as well. For example: a grinding wheel, of sorts, can be made. Turn a piece of wood to a disc on the lathe, then glue a piece of coarse sandpaper to it. When the crude grinder is worn out, just tear off the old sandpaper and glue a new strip on.





Gouge Skew Diamond point

Most inexpensive lathes come without a multi-jawed (also known as the independent) chuck, which is the only one one capable of holding some work. A good improvised one is shown on page 5, figure 4 of THE POOR MAN'S ARMORER. The design is sound but when made strictly to plan, the chuck is inaccurate and even dangerous because of the small surface of the bolts holding the work. Its effectiveness can be improved considerably by epoxying nuts onto the ends of the bolts.

As stated in the very last paragraph of the foot-powered lathe reprint, old files can be ground into excellent chisels (you can even make a hunting knife from one!). The steel is of the proper hardness, and they can be bought at flea markets for as little as a dime each. The most commonly used chisels, as shown on the diagram, are gouges (round nose chisels for rough cutting), skews (used for finishing cuts, as well as for cutting shoulders, beads and grooves), and diamond point chisels (used for scraping, a different form of rough cutting). They can all be made on a grinder in about ten minutes per file. If the newly ground section starts to turn blue-gray at any time during grinding, it's an indication that the hardness is being affected for the worse. Keep it cool by dipping it in water often.

Once you have your lathe and tools, the raw material is needed. Wood prices are already out of sight and going higher, but fortunately this is an area where a lot of money can be saved. Even so, an

There are several ideas you can put into practice right now.

First, turn out the pilot light in the kitchen stove. One summer about three years ago, I noticed my kitchen was five degrees hotter than my living room and I had not lit the stove all day. That pilot light was putting out real heat, not to mention wasting energy I was paying for. I got in there and turned out the pilot and found that my next gas bill was about half that of the previous month.

So the pilot light is not just a cheap convenience. It is expensive, and in warm weather, actually raises the temperature. A carton of matches is no expense at all, compared to leaving that pilot light on 24 hours a day.

Next I considered my living room windows. There are three with an area of 7 by 3 feet each, or 63 square feet in all. Noise came through. Heat came through. Cold came through.

Windows have three basic functions; light, vision and ventilation. During the colder months a lot of energy is used simply to make up for the cold the window panes admitted.

Artificial lighting is much cheaper than heat. The view was nothing I would miss and I felt no obligation to the good people of Eureka to keep my windows uncovered so they would know when I was home and what I was up to. Nor do I feel obligated to save any burglar from destruction by letting him know I am home.

I went to the lumber yard and bought three panels of half-inch fiberboard used both as insulation and sound-proofing. They cost $3.00 each plus 50 cents each for cutting to fit my windows.

Before fitting the panels into the window frames I covered the window sides of the panels with aluminum foil to reflect the heat. This was because, in summer, the windows let in much more heat than was tolerable.

Thus, in summer, I have 63 feet of heat reflector which makes the place a lot cooler. In winter, I substitute the aluminum with black plastic. This makes 63 square feet of heat absorber which makes the place warmer in winter.

You can do the same. Just get 1/2 inch fiberboard cut to fit your windows inside. Cover one side with aluminum foil, or black plastic, depending on the season. Nail the panels into the frames with light wire nails. This way they can be removed in minutes, if necessary, and the wire nails do not damage the wood around the windows. Paint the panels inside with whatever color does it for you. You might even paint outdoor scenery on them.

Since I've had those panels up I've saved about a hundred dollars in gas and haven't needed an air conditioner. They cost me only $10.50, plus $3.00 for the aluminum foil and $5.50 for the large roll of black plastic from the paint store.

I could go hog-wild and do that to all the windows but I just wanted one cozy room since I live mainly in that room with the door to the kitchen closed. A family using this simple system all around could cut utility bills way more than half.

In colder areas this system would be a big help. But you would do better to make thin panels for the aluminum and/or black plastic. Put them in first, then put cut and fitted sections of fiberglass insulation up and then nail in the panels. This would be a little extra work but not much more expense. It could still be removed quickly and would make your home snug in 10 foot snowdrifts.

You may wonder what your neighbors will think if you cover your windows. If you're really concerned, you'd best plan to freeze along with your neighbors. Actually, after comparing fuel bills, your neighbors will copy you.

It stands to reason that you should put insulation in the attic and weatherstripping around your doors. Follow the general instructions on weatherproofing you can get from your local power company.

Next, get wood heaters to replace gas heaters. You can make such stoves from scrap containers or buy them for under $50.00. In them you burn wood scrap and paper. Your life wouldn't be taken up scrounging since your weatherproofed home would require little heat.

If I'm still living here next winter I plan to install a cheap wood stove in place of my pilotless livingroom gas heater. One load of paper, or scrap wood each morning will keep the room cozy for hours after it goes out.

enterprising latheworker can even make a profit using the overpriced lumber. For example; a 4' by 6" by ¾" piece of ash costs $5.40. But from this wood can be made: eight candlesticks which can be sold at five or more dollars each; or six walking sticks which can be sold for six or seven dollars apiece; or more than twenty five tool handles which can be sold for a dollar or more apiece, and so on.

You can make even more profit if you scrounge your wood. Go to a cabinetmaker's or the lumberyard, and ask the man if you can poke around in the scrap bin. If you don't make too much of a nuisance of yourself, he may even let you back for more wood later.

Still another wood source is old furniture. if you can con Grandma into letting you haul away the junk furniture from her attic, you will have hit the jackpot. But before you go wood hunting, you should know what to look for by examining the labeled wood at the lumberyard. Woods to look for are: oak, teak, birch, ash, beech, rosewood, walnut, mahogany, maple, or any other hardwood.

Before you start any lathework, there are a few safety precautions you should keep in mind. Tuck in, roll up, or remove any loose clothing that might be caught in the lathe. Be sure your work is mounted tightly, and that all screws and bolts are tight. Keep your chisels as sharp as you can get them. And never try to make any adjustments to the lathe while it's rotating. Also, don't try to cut metal on the wood lathe, foot-powered or otherwise. Metal can be filed, sanded or polished on the wood lathe, but cutting it requires a fixed cutting tool and a more powerful motor than most wood lathes have. And now we come to the actual lathework. The typical procedure, for the average round object (i.e. tool handle, walking stick, nunchaku) is: first, the work is mounted in the chuck-homemade, screw, dead center or face plate—and the tool rest is mounted as close as possible to the work without actually hitting it. The motor is started at fairly low speed, and the gouge is held at a 30 degree angle on the tool rest. The chisel is moved back and forth across the work, taking off only thin shavings, until the piece is well rounded. Then, the speed is increased slightly, and the skew is put to work for the finishing cut. For bowls, plates and cups, the tool rest is moved around to the front of the work, and the gouge cuts out the inside. After that, the work is sanded and finish is applied, if desired.

The basic cutting methods I've just described are used for many popular projects; this article hasn't the space to go into the more detailed cutting techniques.

Whatever kind of wood stove you get, make sure it has a flat surface. A 55 gallon stove, like on page 217 can be easily flattened on the top side. Just fill it with stacked newspapers to the point where you want the flat area. Then take a sledge hammer and go to work.

The flat area is for a five gallon can of water for showers, dish washing, etc. You can also keep the still going for drinkable water. (Page 81)

Now, what I've recommended can be done whether you own the property or not. No damage is done and although aluminized or black plastic covered windows might look odd in contrast to your neighbors', they need not look ugly or tacky. You can also do these things in an apartment as well as in a private home.

With these simple and inexpensive measures your utility bills will go way down. But that's just the start. What you're aiming at is independence.

A simple solar water heater on your house roof, or even projecting from your apartment window, will replace your hot water heater. Such solar heaters can be made cheaply by anyone at all handy.

Then you will want electricity. The simplest windmills for generating electricity are also the cheapest. Once properly installed, a modestly priced windmill of manageable size will give you most of the power you will need for years.

Then of course, there are home methane generators for stove gas. These systems can also be geared to generate electric power.

Such systems may seem too complex for a layman to implement. But hundreds of thousands of Americans are implementing such systems and they work.

I hope, in time, to detail all the alternative energy systems in THE SURVIVOR. But in the meantime, you should make a collection of all the best material on these systems.

The most compact little book on homemade power is the MOTHER EARTH NEWS HANDBOOK OF HOMEMADE POWER. This book concentrates on simplicity and cheapness and should give even the rankest amateur a system best suited to his own skills and finances. It is a Bantam book and can be ordered through any book store for $1.95.

The next best, or better for the more highly skilled is the ENERGY PRIMER. This details solar, water, wind and bio-fuels.

This is far more detailed than the HANDBOOK OF HOMEMADE POWER but, although it has many ultra-simple systems, it is also crammed with math, diagrams of energy output ratios, etc. Even so, it is a must since it will provide refinements for your systems after you have learned their basics.

ENERGY PRIMER, published by the Portola Institute, can also be ordered through any book store for $5.50 in the U.S. or $6.50 foreign. You might find both books locally.

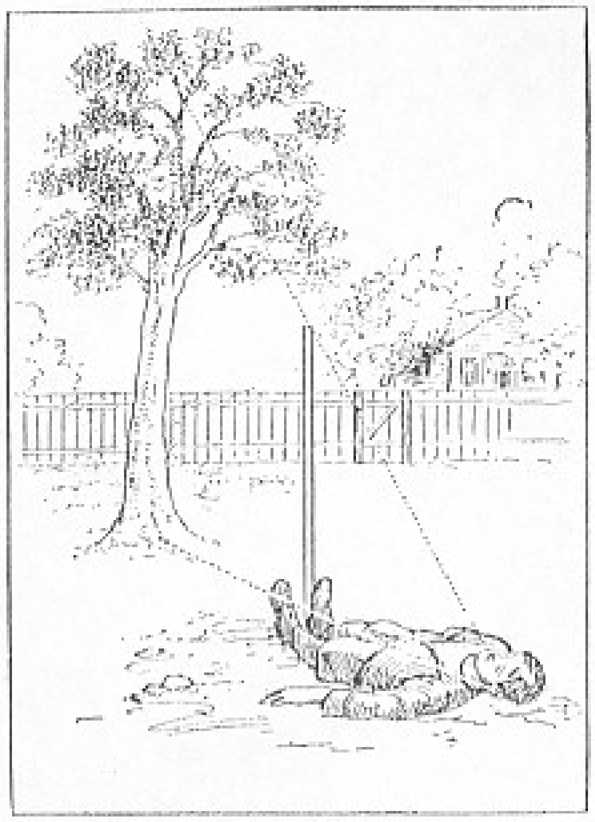
When you look over the wealth of do-it-yourself knowledge in these two books, and others, you can start right in to design your own life-support system. You'll be surprised how simple it is to scrounge materials.

If you will only begin by getting this information, you will be way ahead of your neighbors when they begin getting desperate. This is yet another instance where you help your neighbors and at the same time be recognized as their leader. This, in itself, will greatly increase your overall chances for survival.

At the end of this article is a book list to refer to. These books describe the numerous lathe techniques better than can be covered here.

Getting back to lathework; there's one thing you should keep in mind before applying finish to the completed piece—any objects that will be eaten from must not be coated with standard toxic paint. A non-toxic glazing paint should be used.

Like any craftsman, you have to sell your finished product. Though small arts and crafts stores would probably welcome your goods, it's usually better to be your own salesman at garage sales, swap meets and similar places. Just set up a table of your wares and you're in business. The ladies will buy up all the dishes, cups and objects d' art, while the men will go for the tool handles, walking sticks, and even police-style riot batons. For reasons that elude me, this last item seems to be the big seller. Who knows what the buyers do with the unwieldy truncheons. I imagine most get them to keep in their closet,



Method of Applying the Triangle Measure

Popular Mechanics — 1915

Measuring the Height of a Tree

"Near the end of the season our boy announced the height of our tall maple tree to be 33 ft.

"'Why, how do you know?' was the general question.

"'Measured it.'

"'How?'

"'Foot rule and yardstick.'

"'You didn't climb that tall tree?' his mother asked anxiously.

"'No'm; I found the length of the shadow and measured that.'

"'But the length of the shadow changes.'

"'Yes'm; but twice a day the shadows are just as long as the things themselves. I've been trying it all summer. I drove a stick into the ground, and when its shadow was just as long as the stick I knew that the shadow of the tree would be just as long as the tree, and that's 33 ft.'"

The above paragraph appeared in one of the daily papers which come to our office. The item was headed, "A Clever Boy." Now we do not know who this advertised boy was, but we knew quite as clever a boy, one who could have got the approximate height of the tree without waiting for the sun to shine at a particular angle or to shine at all for that matter. The way boy No. 2 went about the same problem was this: He got a stick and planted it in the ground and then cut it off just at the level of his eyes. Then he went out and took a look at the tree and made a rough estimate of the tree's height in his mind, and judging the same distance along the ground from the tree trunk, he planted his stick in the ground. Then he lay down on his back with his feet against the standing stick and looked at the top of the tree over the stick.

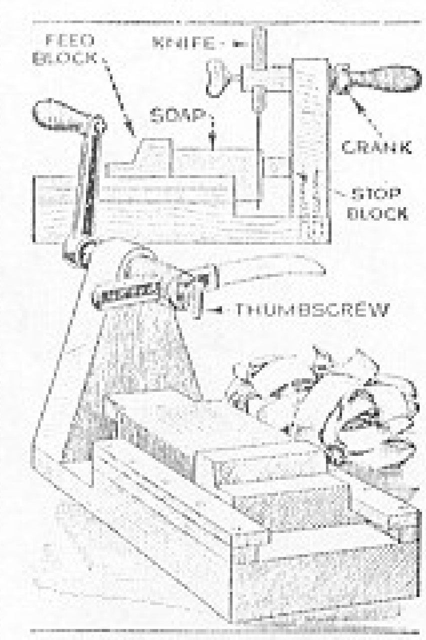
If he found the top of stick and tree did not agree he tried a new position and kept at it until he could just see the tree top over the end of the upright stick. Then all he had to do was to measure along the ground to where his eye had been when lying down and that gave him the height of the tree.

The point about this method is that the boy and stick made a right-angled triangle with boy for base, stick for perpendicular, both of the same length, and the "line of sight" the hypotenuse or long line of the triangle. When he got into the position which enabled him to just see the tree top over the top of the stick he again had a right-angled triangle with tree as perpendicular, his eye's distance away from the trunk, the base, and the line of sight the hypotenuse. He could measure the base line along the ground and knew it must equal the vertical height, and he could do this without reference to the sun. It was an ingenious application of the well known properties of a right-angled triangle.—Railway and Locomotive Engineer.

Popular Mechanics — 1925

Simple Soap-Chip Cutter

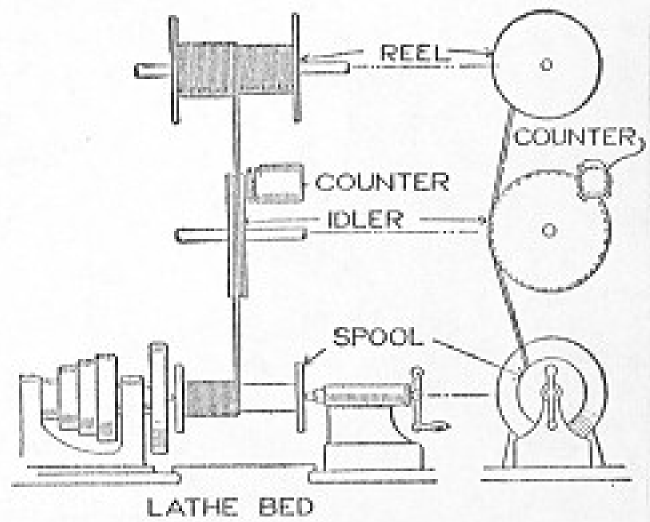
A handy contrivance for use in the kitchen is a soap-chip cutter of the type illustrated. It consists of a base, the construction of which is quite clear from the drawing, provided with a sliding block to feed the soap to the knife. A stop block, screwed to the head and projecting close to the knife blade, determines the thickness of the chips. The whole device is made of wood, with the exception of the crank and cutter head, the latter being made of ⅝-in. cold-rolled steel, turned down at one end to fit the hole in the bearing, and having a slot and a thumbscrew in the end to hold a paring knife; the crank is either taken from a junk pile, or made of flat iron, and provided with a wooden handle. In use, the bar to be cut is inserted between the feed block and stop, and is pushed toward the head with the left hand, while the crank is turned with the right. The cutter may also be used for making potato and apple chips.



Popular Mechanic 1918

Measuring the Length of Wire Wound on a Spool

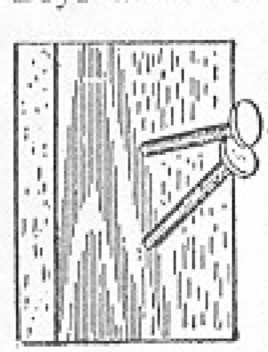
When winding magnet spools on a lathe, the exact amount of wire used can be easily determined by means of the device shown in the illustration. The large reel from which the wire is obtained is conveniently placed on a loose mandrel, or rod, near the lathe, and in line with the spool which is to be wound. A grooved idler wheel, the exact diameter of which is known, is supported between the spool and wire reel so it may freely revolve; the number of its revolutions should be obtained, automatically, by a revolution counter. When using the device, the wire from the reel is placed once around the idler to insure the necessary grip to prevent it from sliding; then it is led to the spool. The exact diameter of the idler being known and the number of revolutions indicated, the true length of the wire wound on the spools can be easily determined by the following formula: Length of wire on spool in feet equals circumference of idler in feet times number of revolutions of idler.



Measuring the Length of Wire on a Spool with the Use of an Idler and Counter

Popular Mechanic 1915

To Hang Heavy Things on a Nail



Boys will find many places around the house, where a hook to hang things on will be a great convenience. Instead of buying hooks use wire nails, and if driven as shown in the cut, they will support very heavy weights. Drive the lower nail first.

PLAN AND SURVIVE

Author Unknown

NOTE: The prices listed in this booklet were current in 1959. Some were at bulk rates and others individually priced. Due to fluctuations in prices, it is impossible to give more than suggested prices as a guide. All prices were maximum. Many would be lower if large groups ordered together in quantity.

This booklet has been compiled to assist those who wish to prepare for their time of need, whether it be an economic need or an atomic disaster. Keep in mind that you will either have to hole up and survive, perhaps in your basement; or you will have to pick up what you can carry and run.

If you have to run, you should be prepared to survive in the wilderness or, in case of a disaster, you would have to live without water, electricity, gas, etc. You would probably have to spend many days in your basement, not daring to go out because of radiation or rioting.

Try living in your own home for a week under these conditions. Shut off the water, power, gas, etc. Dispense with all purchases . . . DO NOT BUY ANYTHING . . . then see how prepared you are for coming events. How long can you live entirely from the food most people have been storing, without nutritional deficiencies? The purpose of this booklet is to provide information about necessary foods and how to use them to prevent nutritional deficiencies.

The program outlined on the following pages has actually been lived for a period of six months by the author, his wife, and five children. During this period the family was actually more healthy than they had been during previous years even though 90% of the diet was derived from the Basic $50.00 food kit. The other 10% was composed of salad vegetables and home bottled fruit. So here is a program that has been tested and works.

The One Year Program is to give a good minimum nutrition and keep the person healthy, mentally alert, and active.

This basic diet can be supplemented with fresh vegetables, wild plants, etc. if available. Every individual should familiarize himself with the method of sprouting seeds for food. Full details for sprouting will be given in this booklet.

Nature provides for us a complete health program if we take heed and learn how to use these natural foods to build strong healthy bodies. You will find further on in this booklet a few health hints that might become useful to you in your time of need.

The following information has been compiled from many authenticated sources, historical records, nutritional books, biochemical studies, recent laboratory findings, pioneer journals, and the author's personal experiences from hundreds of experiments which were noted during 15 years of study on the subject of nutrition. Of necessity, this publication is brief.

(Your basic 6 months' food supply)

By investing as little as $50.00 now, you can assure your family enough food to eat for a period as long as six (6) months. This is not theory but FACT since my family and I actually lived for an entire winter on this exact food. We experienced less sickness that winter than we had in previous years. The only other food was some home canned fruits and vegetables.

This is your basic $50.00 six months storage supply:

*Ls	100#	Red (chili or pinto) beans	$10.00
*L	50#	White beans	4.50
*L	100#	Dry milk powder	19.00
*LS	20#	Whole peas	3.00
*L	100#	Rye	5.00
*L	100#	Wheat	5.00
*Ls	100#	Corn (white or yellow)	6.00
			$52.50

The beans, peas, and wheat should, to a great extent, be sprouted to supply the Vitamins B and C and available protein. All items to be highest nutritional quality available; organically grown if at all possible.

This is planned as a subsistence program and should not be expected to give sustenence for a longer period.

To add variety and assure a more adequate diet, we have this additional list which, if added to the previous one, will constitute a one year supply.

To assure fresh vegetables which may not be available, those items with astericks in the previous list may be sprouted to supply the live factors to your diet. In addition the following may also be added for sprouting:

			$52.50
L*S	25#	Alfalfa (choice sprouts)	$ 11.85
L*S	15#	Lintels (in salad)	8.88
L*S	50#	Mung beans	13.85
L*S	25#	Soy beans	3.82
			$ 38.40
6		tray sprouting kit complete	6.50

FOOD KIT

Additional Food For One Year

L*s	300#	Wheat w/20% rye	$ 16.50
L s	100#	Dry milk (drinking, baking, eating, etc.)	19.00
L s	100#	Dry buttermilk (for Yogurt and baking)	18.00
S	60#	Raisins in baking or as is	15.00
S	60#	Black figs (good digestive regulator)	8.00
S	30#	Prunes (good digestive regulator)	7.00
L S	25#	Dry dates (sweetener)	6.00
S	50#	Apricots (dry them yourself) best fruit	
L*S	10#	Millet (cereal and flour, blends	2.00
L*S	50#	Sun flower seed, hulled (as is, in drinks, and confections)	38.30
L*s	10#	Buck wheat (cereal and meat loaf)	2.75
L*S	20#	Sesame seed (in drinks and seasoning, baking)	8.64
L*s	25#	Lima beans (good protein)	8.00
			$149.19

THINGS TO REMEMBER

We may get out of town if we leave early enough, but the roads will be jammed and most of us will have to sweat it out in our own basements without heat, light, food, or clothing unless we provide these necessities now. There may be looting, pillaging, and much bloodshed. You should be prepared to protect your own women from being ravished, defend your meager store of food from rioters and looters who will come to steal it from you at gun point.

It is possible that all vegetation will be contaminated with fallout, much of the soil denuded and sterilized, and possibly no living thing would be safe to use as food for a period of time.

You must so arrange your storage that you can pick out the most essential things and run with them. The few roads through the mountains could easily be washed out by sabotage of the dams. The roads between cities could be blocked off or destroyed and we would sit like rats in a trap.

Always keep this in mind. A person can live four (4) minutes without air, four (4) days without water, and forty

(40) days without food. So they become important in that order: air, water, food.

Learn to make such things as a home made gask mask from materials available in your home. (See instructions under FIRST AID section).

The first thing to do when given an "alert" is to shut off the water, gas, and power where these services enter your house. This would give you a 30 to 50 gallon water supply which, if properly rationed, could last several weks. One quart of water per day per person for food preparation. Shutting off gas and power could prevent fire.

NOTES ON SPROUTED SEED

Why Sprouted Grains in a Survival Kit?

1. They are compact, 20# yielding 400# of food.
2. They are inexpensive, 500# costs only $7.50 to produce.
3. Highly nutritive. Cathryn Elwood, in her popular book, "Feel Like a Million," considers them as probably the most nearly perfect of all foods. High in the B Vitamins, minerals, proteins, Vitamin C, and enzymes. In fact, 10 to 50 times richer in these vitamins than original seeds.
4. Quickly produced. Two to four days from planting to harvest.
5. Tasty and easy to learn to like.

THE MOST SATISFACTORY WAY TO SPROUT SEEDS

Make trays of ¾ inch redwood, 2 inches deep and 10" x 10½" inside dimension. Tack screen (fiberglass, bronze, or stainless steel) on bottom. Cover screen with washcloth, sprinkle seeds on the cloth, cover with another cloth, and keep cloths damp. Water two to three times daily. Place in a dark place at temperature about 70 degrees. Trays may be stacked on a cookie sheet and thus by watering the top tray, they would all be watered. These trays may be made to fit in a square 5 gallon can for a cabinet to make it portable and keep seeds from drying out too rapidly. The beans may be sprouted in a SteaMarvel in a two to four quart stainless steel pan.

The seeds that are easier to sprout, such as alfalfa and radish seeds, may be sprouted in a two quart bottle.

Place about 4 tablespoons of seed in 1 cup of spring water and soak overnight. Drain off water, the next morning, and place seeds in bottle. Place a piece of nylon stocking over top of bottle held securely with a bottle ring. Water and drain three to four times daily. When you water, pour original water over seeds and allow to stand for a few minutes then pour off water and save, adding more fresh water as needed. Untreated spring water or distilled water is best. You may add one tablespoon of kelp powder to each gallon of water to feed the sprouts and increase the available iodine and minerals.

Alfalfa, radish, lintels, mung beans, and green peas are generally used raw as any salad vegetable or, if heated, should only be heated for a few minutes.

The navy, chili, pinto, and soy beans need not be sprouted more than two days. They can then be cooked in twenty minutes instead of three to four hours. They do not cause gas, when digesting, if they are sprouted. They are good in casseroles, salads, meatless meat loaves, as main dishes. Each adult person should have ½ cup of sprouts twice daily to assure adequate nutrition under this program. All of the sprouts may be juiced as a good source of vitamins and minerals, especially rich in Vitamin C complexes. (See uses under NATURAL FIRST AID note).

HISTORY REVEALS USE OF SPROUTS

When making bread, you might try this recipe taken from the Dead Sea Scrolls: (the bread eaten at the time of Christ in Palestine)

Sprout 2 cups of wheat for 1½ to 2 days. Pour off excess water. Use the water in drinks, soups, etc. Mash up sprouted wheat. This can be done with a blender or the Champion Juicer if electricity is available. If not, a meat grinder is handy or a rock or hollowed out log with a tamper to pound into dough. Make a flat pad about 1/8" thick from this dough. Bake on a stone or a pan in the sun from morning until noon on one side and then turn over and bake until evening. It is sort of a hard tack but very tasty.

YEAST RAISED SPROUTED WHEAT BREAD

4 cups sprouted wheat as prepared above
3 teaspoons of yeast
Salt if desired
Let double in bulk and bake in oven at 425 degrees for 30 to 40 minutes.

MEATLESS MEATLOAF

A delicious meatless meatloaf can be made from any of the sprouted beans. Grind beans coarsely. Add egg, cheese, milk powder, vegetable powder, garlic oil, soy sauce, etc. Make into pads and pan broil or make into loaves and bake.

Mung beans are delicious if wilted in a pan with chopped onion and oil and served with soy sauce.

The Hunzas in Northern India make a whole grain bread called *chapeties* from various grains ground and made into a stiff dough. Roll out pieces the size of walnuts, paper thin, and cook only a minute on each side. This is tasty, easily made, and may be cooked on a hot rock.

Sun flower seed is a food from the East, an excellent source of highest quality protein, rich in essential polly unsaturated fatty acids (Vitamin F) and many other vitamins and minerals. A real valuable additive to any diet. Use as is, in salads, desserts, mixed with fruits to replace candies. Also excellent in baked goods.

Millet is a staple food from India, a cereal grain, one of the world's finest and most complete foods. Alkaline in nature. One scientist has made the statement that, if he had to choose one food on which to subsist, his choice would be millet. Millet is that perfect a food.

Sesame seed is also from the Near East. Remember Ali Baba's magic words "Open, O sesame!" Sesame seed contains almost magic nutritional values. Sesame seed is a rich source of Vitamin T, (thought to prevent respiratory infections), rich in other vitamins, protein, and oil. You can make your own delicious salad oil from sesame seed by thoroughly mashing seed and adding some water. Mix thoroughly and add vinegar (1 Tablespoon per cup). The oil will separate to the top. The lower part makes good salad dressing and sandwich filling base. Just store in cool place over night, then pour off oil.

Carob, the St. John's bread or Locust bean (tree pod) spoken of in the Bible (locust and honey) makes an ideal food, rich in calcium and low in fat calories. It looks and tastes much like cocoa or chocolate and is used as a chocolate substitute, but does not prevent assimilation of calcium as does chocolate, nor does it have the detrimental alkaloids, caffeine and theobromine which have serious effects on the kidneys. Carob may be used in anything chocolate and cocoa are used in. It is also good in drinks. One tablespoon carob, 1 tablespoon brown molasses, 1 cup milk. Very tasty and extremely nutritious. Mixed with water, carob is good for diarrhea and is being used by the medical profession for this purpose.

CAROB MIX

(Used for a Meal or a Confection)

2 spoons rice polishings (if available)
2 spoons soy powder

1 spoon brewers yeast
2 spoons carob powder
2 spoons sunflower seeds
2 spoons coconut (ground)
1 spoon oil (soy, sesame, etc.)

Mix and knead thoroughly. Add 1 spoon honey or molasses to bind and sweeten. Only a small amount is needed for nutritional need and it is very filling.

WHOLE WHEAT BREAD

Heat the following ingredients after mixing, to luke warm:

½ cups milk powder
3 cups water
2 teaspoons salt (VegeSal or sea salt)
2 tablespoons molasses (keeps bread moist and prevents crumbling)

Add the following, mix and let rest for 10 minutes:

1 package dry yeast   6¼ cup whole wheat flour
¾ cup rye flour   ¼ cup carrot (mashed)

Use 1 cup for kneadings and shaping of loaves (8 cups flour in whole recipe for 2 loaves). Knead well. Set aside in covered kettle (not aluminum) which has been coated with oil to prevent sticking. Let rise until double in bulk. Have oven at 375 degrees F. and bake for 15 minutes. Then turn temperature to 350 degrees F. and bake 35 minutes more. Butter top crust. Cool on rack uncovered for a few minutes. Then cover with towel and finish cooling. Store in bread box.

NOTE: No shortening of any kind is used in this recipe.

PANCAKES

1 cup wheat flour
2 teaspoons baking powder (Royal)
½ teaspoon salt (VegeSal or sea salt)
1 teaspoon honey
1 cup whole milk
1 egg
1 teaspoon butter

Sift dry ingredients. Add milk to beaten egg and mix with above ingredients. Add melted butter. Amount: 12 small pancakes.

MUFFINS

2 cups wheat flour
4½ teaspoons baking powder (Royal)
3 tablespoons honey
½ teaspoon salt (VegeSal or sea salt)
1 egg
1 cup whole milk
2 tablespoons shortening

Sift dry ingredients. Add milk to beaten egg and mix with dry ingredients together with melted shortening. Place in well greased muffin tins and bake at 450 degrees for 20 minutes or until golden brown. Amount: 12 small muffins.

WILDERNESS SURVIVAL

If in the wilderness, you can use many weeds for survival, such as burdock roots and shoots. These are very tasty when rolled in egg and fried. It tastes similar to fish.

Fern shoots are tasty and can be used as asparagus. They should be young and tender.

Dandelion leaves are good for salads and greens. The weed root toasted makes an excellent coffee substitute.

All mushrooms, if grown in wood, are edible. There are many other edible varieties, easily recognized. You should become familiar with these mushrooms.

Make your plans where you can go, scout out the area, find out how it would be all times of the year. Familiarize yourself with the vegetation, perhaps even plan a shelter. As you know, gas will probably be impossible to obtain due to a power failure. If you plan to drive far, have gas on hand or a hand pump available.

These are items to be checked over. They will be very beneficial:

Additive to Your Diet

Prices effective 1959

		95
S	5# Soy lecithin	11.50
LS	25# Primary nutritional yeast	16.00
Ls	10# Brown rice (E and B Vitamins)	1.94
*RS	25# Raw peanuts (protein, polly unsaturated oil, digestive aid)	7.50
L	2# Baking powder (Royal Brand) no aluminum	1.00
LsS	5# Vegetable broth powder (soup, broth, alkaline drink)	7.50
Ls	25# Potato flour (mashed potatoes, bread, hot cakes)	4.65
LsS	10# Carob powder (chocolate flavor, drink, etc. Also beneficial in treatment of diarrhea	9.83
LS	1# Garlic powder (treatment for colds, respiratory, and intestinal disorders. Regulate blood pressure, etc.)	4.95
LsS	2# Paprika powder (source of Vitamin A, flavoring)	3.20
LS	½# Golden Seal (Universal Herb. Virtually all uses)	3.50
L	2# Mint leaves (flavoring and tea to aid digestion	2.30
LSs	¼# Cayenne (good for most sicknesses	.60
S	200 count 2/0 empty gelatin capsules (to be used to administer herbs, cayenne, garlic, Golden Seal, etc.)	8.80
LS	1000 count 500 mg tablets Vitamin C.	12.00 synth.
	Natural more effective	18.00
LS	1000 kelp tablets or 20# powder same price	3.60
LS	1000 bone meal tablets	14.00
	2# Charcoal (make from apricot shell or pits)	
	5 gallons molasses (sweetener, poultices, etc.)	11.00
	5 gallons honey (sweetener, poultices)	12.00
	5 gallons soy oil (cooking, salads, etc.)	10.80
	6 pints fish oil (natural, Vitamin A & D)	7.50
	4# Dry active yeast (baking bread, etc.)	3.80
	12 pints MiVita Mineral solution (burns, cuts, mineralize)	18.00
	1# Bentonite Clay (poultices and cream for burns, radiation, weather protective and intestinal detoxifier	.75
	6 pints cider vinegar (herbing, salads, enemas, first aid dressings)	3.80
	2# Natural rock calcium powder	.25

"Only Nature can repair the machine which Nature has made."

—Sir Arthur Keith

SOME NATURAL FIRST AID IDEAS

Here are a few ideas of Natural First Aid (for a more complete discussion, refer to the booklet on natural first aid by the author of this booklet.

FOR BURNS — flash burns, sun burns, exposure, scalds, all burns. As quickly as possible, do one of the following:
Apply fresh egg white to burned area.
Immerse in mineral solution (MiVita, Colloidal Gold, Clarkes Mineral, Nature's Minerals, etc.), or apply cotton completely saturated in this solution. This is terrific to relieve pain and to heal. Most pain will subside in 20 minutes, even on rather severe burns.
If skin is not broken, apply Bentonite Clay Cream.
Honey is a good healer if burn is not too severe.
Many burns respond favorably to grated potato poultice. Grate potato onto cloth and apply to area. Change every ½ hour. Also good for poison ivy, rash, acne, dermatitus, diaper rash, hemeroids, sore feet, blood poison, infected wounds, and skin ulcers.

CHAPPED SKIN — responds favorably to the following:
1. Raisin lotion. Mash up raisins into pulp and add water to make lotion.
2. Molasses. Good for pimples and other skin eruptions. Apply locally and leave on at least ½ hour.
3. Any of the suggestions for burns.
4. Honey and corn meal is good skin cleanser and beautifier.

DYSENTARY — This will be a common disorder because of sudden change of diet.
1. Mix 1 teaspoon Psyllium Seed, 1 teaspoon vegetable pwder, 1 tablespoon whey powder, in 1 glass of water, stir, and drink quickly. (Other than infants.)
2. For infant or Child: Gruel made from barley or rice. One tablespoon to one pint of water. Cook ½ hour. Use liquid only (strain).
3. 1 tablespoon of charcoal and ½ teaspoon Bentonite Clay is also helpful.
4. Use drinks made with carob powder to soothe the bowels. One tablespoon in one glass of water, etc.

HYPER ACIDITY — Drink several glasses of water. Take a little vegetable powder with calcium powder (½ teaspoon each).

HEADACHES — Enemas usually relieve this condition. If this continues, use Coveilla Tea: ½ cup twice a day on empty stomach. This is also good for ulcers and seems beneficial in nearly every internal disorder.

THE COMMON COLD — Stop eating. Enemas. Take 2 capsules of cayenne pepper, two capsules of garlic, and ½ cup of Coveillia Tea. Stay on liquids for a day or two.

SORE THROAT — Mix equal proportions: potato juice, honey, onion juice, and vinegar. Gargle every 15 minutes. Standing on your head is good. The Lion Exercise is also good because it opens the blood vessels and increases circulation to the throat area; thus relieving congestion. The Lion Exercise is executed by sitting erect on the floor with legs crossed, hands extended over knees, force fingers apart, chin in, mouth open wide and tongue extended as far as possible, eyes looking at nose. Take a half breath and hold, forcing the diaphram up. Put entire body under tension and hold tension about 30 seconds or more. Repeat several times.

SPRAINS — Apply cold packs immediately and, after 20 to 30 minutes, soak cloth in rubbing alcohol (warm, turpentine (one tablespoon to 1 quart hot water apply cloth warm to the area. Alternating cold and warm packs. At same time take, internally, one quart almond milk, two tablespoons bone meal powder, two tablespoons Rose Hips powder.

MINOR SPRAINS, BRUISES, AND STRAINS — Make tincture of arnica or sage. Arnica is a wild flower that grows abundantly (a small yellow sticky flower that grows about two feet high). Fill bottle full of blossoms of flower or of sage leaves. Fill with rubbing alcohol, let stand overnight, strain, and rub area with solution (not to be taken internally.)

EARACHE — Small slice of garlic buttons or garlic powder on piece of cotton. Place loosely in ear. Put heated towel, etc., over ear. Onion may be used but is not as effective. Give above treatment for temporary relief then: Take four ounces potato juice with one ounce green leafy vegetable juice in the morning and 4 ounces potato juice with 6 ounces of cucumber and two ounces green pepper in afternoon on empty stomach. (when using potato juice, let starch settle out and only drink liquid.)

TOOTHACHE — For temporary relief, snap clothes pins on ends of fingers on the side of body tooth is giving trouble. Remove after 15 or 20 minutes and repeat later if necessary. Use potato combination (above) and take one to six tablespoons bone meal daily. Rinse mouth with warm water: 1 cup with 7 tablespoon calcium powder. Take 2000 mg. natural Vitamin C every two hours.

EYES — Eye strain — Drink carrot juice. Splash cold water in eyes to increase circulation. Looking at sun and blinking eyes (squeeze tightly). Other eye exercises relieve strain.
Potato juice combination good. If irritation severe or in a case of pink eye or sty, a potato poultice is good. Grate potato (pealed and cleaned), place over closed eye with person lying down, squeeze juice from excess potato onto poultice. Keep on 20 to 30 minutes. Repeat if necessary.

FEVER BLISTERS — 1 pint almond milk with 4 tablespoons bone meal.
1. 1 tablespoon whey with 1 teaspoon calcium powder and 1 tablespoon vinegar. Mix quickly and drink.
2. Raisin poultice.

FRICTION BLISTER —
1. Vinegar poultice (saturated cloth)
2. Sugar poultice, honey poultice, sugar and salt poultice. Any of these are followed with potato or raisin poultice.

To clean skin, use 1 cup honey, 1 cup water, 1¼ cups ground corn meal. Scrub skin, let stand few minutes (20) and rinse off in water (no soap).

ACHING FEET AND LEGS — 2 gallons water, 1 tablespoon mustard. Soak feet in mustard water 20 to 30 minutes. Soak feet in kelp water ½ to 1 cup kelp to 2 gallons warm water. After soaking, lie on back with legs extended into air and shake vigorously for 30 seconds. Hold still for 1 minute. Then relax. Preferably on a slant board or with head lower than feet.

WARTS, STONE BRUISES — Milk weed juice placed over wart several times daily, completely saturated. Also potato poultices.

POISON IVY AND POISON OAK — Masticate potato leaves to pulp, place over affected area for 20 minutes to ½ hour. Repeat if necessary.

INSECT BITES — Apply ammonia water, alcohol, tincture of arnica, potato poultice, mud, clay, vinegar and charcoal, lemon (cut in-half) and place over wound.

PIN WORMS — 1/8 teaspoon garlic powder, 1 tablespoon dark molasses. Take every third day for three times. Estimates state that about 90% of people have pin

worms. Symptoms are itching at rectum, nerves, chewing and grinding teeth at night.

RESPIRATORY CONGESTION—Steam vinegar and water and inhale vapors.

1. 2 garlic pearls and 2000 mg of Vitamin C every two hours and 1 tablespoon bone meal and ½ cup Coveillia Herb Tea twice a day.
2. Apply onion, red pepper poultice to chest and/or throat. About 1 teaspoon red pepper to 2 to 3 cups of grated onion. Mix together, apply about 1" thick to cloth and place over affected area.

OPEN WOUNDS — If dirty, wash with water and salt. (1 quart with 1 tablespoon salt). Then apply mineral water (MiVita Mineral or Clark Mineral, Colodial Gold, or Nature's Minerals). You may need to bathe with saturated cotton.

INFECTED WOUNDS — Salt and vinegar poultice, potato poultice, lemon slice. Keep loose bandage until scab forms, then open to air.

BODY TONE UP — Headache, fever, nausea, flu, fatigue. Apply an ice pack to abdomen for about 1 to 2 hours before arising then take enema. Put 1 to 2 trays of ice cubes in plastic bag and place on a moist towel over abdomen. Cover with dry towel.

DIET IDEAS

If you start the day with an herb tea or fruit juice. you start the day with a light heart.

Under survival conditions, I might suggest that you eat only when hungry. Do not attempt to follow a schedule of three meals per day. Oftentimes one meal and one or two snacks per day will suffice. The snacks would be three to four hours apart. (Do not MINCE!)

An average dietary would consist of something like this: Peppermint tea on rising (or a fruit juice). A handful of seeds and nuts.

For lunch a few dried apricots and nuts and perhaps a drink of carob and dried milk with molasses.

For dinner, a large salad with sprouts and herbs. One main dish from beans, peas, or nuts. This could be bean patties, chilli, meatless loaf, etc. Use yeast and dry milk with all bean dishes and cereal foods to complete protein structure.

It is possible to get along on much less food than the average person in America actually consumes. Foods listed here are high in nutrition, much higher than average diets, therefore, less actual food is needed. You can live on 14 ounces of food per day and 16 ounces of liquids if it becomes necessary to do so. But be sure the food is highest quality nutrition wise.

I do not recommend commercially processed, canned, or prepared foods of any kind because of their high cost, large bulk, and questionable nutritional value.

Cereal can be made from any of the grains and they may be sprouted, mashed, and mixed with fruit. Make milk from dry powder or fresh nuts (ground). Corn is used as cereal, corn bread, or as tortillas, etc.

Whole sprouted peas are delicious, just like fresh June peas. Eat raw or slightly warmed.

Wheat and rye mix for better protein structure and mineral balance. Make bread and cakes from yeast-raised sprouted grains. Always add 2 tablespoons nutritional yeast for each loaf of bread.

Make your own yogurt from dried milk and dried buttermilk powder. About 1 cup buttermilk powder and ½ cup dry milk per quart of luke warm water. Try to keep a culture of good quality yogurt alive and use this to incubate milk. Keep milk warm like baby bottle (112) degrees) for four or more hours after mixing with 1 cup of prepared yogurt.

You may start a culture of wild lactabacteria by placing a shallow pan of milk in open air until it becomes clabbered. If it is tasty, use it to start yogurt culture. It is also possible to get wild yeast started this way. Use soft dough mixture of wheat and water and keep warm in open air until it developes a culture of yeast. Use this as a sour dough in making bread. Keep some of this sour dough from one baking to the next. Place a small amount of this active dough in potato water and keep at room temperature. Use this liquid to mix bread dough.

Juices may be made by grating product on good stainless steel or plastic grater, and placing pulp in linen cloth and squeezing cloth in hands.

Charcoal may be made from willows or from apricots or peach pits. Place them tightly in an empty coffee can, with a couple of small nail holes in can. Place can in fire, watch flames eminating from holes. When flames change to yellow-red, take out of fire and let cool. The charcoal should be completely charred but not ash. Experience will tell you how much is necessary.

This is a simple, sure, way to store wheat, corn, rye, beans, peas, rice, millet, buckwheat, sesame, and all other cereal grains and seeds. This storage process I call the "Inert Gas Storage" as virtually all the air is removed from the container. If there is little or no oxygen present, animal life can not exist and rancidity is drastically reduced.

For each gallon capacity of container, use 4 ounces of dry ice. Place dry ice in bottom of container and fill container with product to be stored. Keep container perfectly level, do not move, tilt, or agitate it. Product should be at storage temperature or a few degrees higher. Now cover container (not air tight). The excess air and gas must escape from container.

Only after all tho gas has escaped and the dry ice has evaporated, is it possible to seal container. I have sprouted seed stored this way after 3 years of storage. I cannot be sure of the shelf-life on every product. Only time will determine this factor.

Do not store or subject foods to be stored, to high temperatures (over 105 degrees F.) Do not subject to sun's rays after harvesting. Do not attempt to store under-developed grains, uncured, or moist seed products. Allow all products to reach a standard moisture content by storing a couple of months in cloth bag first. Store products in a dark dry cool place, away from possible contamination and where they would be readily accessible under emergency conditions.

One of the simplest ways to remove weevil, etc. from grain if it is infected and must be eaten, is to pour into shallow pans and place the pans near an ant bed. The ants will do a thorough job of house cleaning in just a day or so. After this, blow grain and wash in sieve under running water and you have clean grain that can be used for most things (not recommended for sprouting however).

It seems to me that the grain produced on poor soil under unfavorable conditions is much more subject to infection with bacteria. I have never had trouble from grains which were produced under organic culture or biodynamic culture conditions, even when stored in open storage near infested grain.

Paying a little more for a better quality product is a wise investment. Try to get at least 16% protein, preferably 18%. Biodynamically produced grains will test up to approximately 30% protein. The average farmer will feel lucky to produce 10% to 12% protein wheat. Doesn't this tell you the story? Naturally you will get 3 times the protein from 30% wheat that you would get from 10% wheat and the quality of every grain of the 30% would likely be more superior in the important amino acids, less storage space, less food to prepare, better storage, less loss, better taste at actually less money invested in the long run. All this from proper selection of foods.

When purchasing the sed and nuts, I would suggest that they be obtained in 1# and 2# hermetically sealed cans for long storage. Here a little more cost will pay off in better

quality and better storage. *Sartrite* organic nuts and *Barth's* organic seeds (sunflower, pumpkin, and others) are both excellent brands, finest quality and flavor, economically priced, excellent storage qualities, easily stored for 5 years under good conditions. I, personally, rotate these on a 3 year program. I buy ½ again as much as I use, each year, and I always use the older product first. So, in 3 years, all seed and nut products are replaced, once or more.

The dry fruit can be handled this way: dates are obtainable dehydrated, organically grown *Covalda* dry date pieces. The other fruits — raisins, figs, prunes, etc. (organically grown) are obtainable in 30# and 60# boxes. Spread them out on a screen (drying rack) in the sun and finish drying them until hard and crisp. You can then store them by placing them in bottles and seal. It will be necessary to rub these in water or soak overnight to soften and plump them before you use them.

Potatoes and carrots may be stored in the autumn of the year in your root cellar.

Squash, apples, and pears can also be stored for winter use.

An old refrigerator buried in the ground with the door facing up, makes an ideal root storage. Be sure the lock is jimmied so children cannot become trapped in it. Fix to be padlocked.

Clothes as you might require. Extra shoes, underwear to warmer clothing and other items of your own personal selection together with the following:

Needles and threads, scissors, string buttons (boxed up), 3 sets underwear, 10 pr. hose, 2 pr. suntan suits, 2 pr. work shoes, heavy coat and hood, heavy insulated trousers, 2 pr. heavy wool sox, 2 sweaters, 2 hats (rain and cold special).

Packet of vegetable seeds that could be eaten or planted (10# packet prepared for long time storage):

lettuce	green peas	spinach	garlic
beans	tomatoes	cabbage	parsley
beets	cucumbers	radishes	cress
carrots	squash	onion	

All seeds packed into sealed containers could be eaten, as is, sprouted, or planted. All seeds free from chemical contamination, not treated as are commercial seeds, etc. When you buy, be sure to specify UNTREATED so they can be eaten or planted.

Camp Equipment

2 long handled thick iron frypans
4 or 5 (2 to 6 quart) stainless steel pans
1 grill plate
1 collapsible grill
1 mortar and pestle
long handled forks
plate, cup, and eating utensils

FIRST AID

box of cotton	bottle ammonia
box of cheesecloth	chlorophyll cream
package of elastic	Vitamin F cream
package of sterile gauze	MiVita Minerals
roll of adhesive tape	Nature's Minerals
bottle of tincture of iodine	dental floss
band aids	surgical needle
syllium seed powder	surgical scissors
surgical suture thread	small mortar and pestle
bottle alcohol	

old cleaned sheets, torn and boiled or baked sterile and packaged.

THESE HARDWARE ITEMS WOULD BE USEFUL

SL	wheat mill, hand operated	$ 4.00
SL	soap, hand soap and laundry soap .. (include instructions for making soap from wood ashes and fat)	10.00
SL	bow gun 200# pull w/arrows	17.50
SL	hand pump, 15 feet hose (pump gas, water)	23.00
SL	sling shot — 200 steel pellets (to kill rabbits, etc.)	1.50
SL	pocket knives (Tree brand)	3.50
SL	Zippo cigarette lighter, fluid and flints	1.25
SL	500 feet good rope	4.80
SL	small transistor radio and batteries	22.00
SL	self generating flashlight	4.95
SL	48 candles (wax) long burning type	2.00
SL	assorted nails	
		$109.50
		$635.81

Items you probably already have on hand, put together in an available place so you know where they are:

L claw hammer (strong) 25#
screw driver, tin snips, razor knife, extra blades, pliers (wire cutting type)
hand ax, shovel, pick, cord saw, roll of fine wire two chisels, hand saw, blades, fine file.
gun and ammunition
sleeping bags or bed roll for each member of the family
tent
auto top rack
traps or roll of polly film (ground cover, shelter, etc.)
set of fishing gear
prepare box or two of matches by dipping in melted wax
Several good book packs of matches
dufile bags
100 gallons of gas in 5 gallons

SUMMARY

"If you do not take care of your health, you will have to take care of a sickness."

—Dr. Bernard Jensen

You would do well to learn the uses of the natural foods listed in this booklet and begin preparing your body now so that you may be better able to face the unknown.

In summary, this is what your kit should contain:

1.	Basic six month survival kit, approx. cost	$ 52.50
2.	Seed sprouting kit (will supply 1500# fresh vegetables) includes trays	44.90
3.	Basic 1 year kit	149.19
4.	Supplementary food kit	239.47
5.	Hardware kit	109.50
6.	Natural first aid kit	11.10
7.	Vegetable seed packet	12.00
		$618.66

(Start your program with numbers 1 and 2)

EXPLANATIONS

1. All items marked with an asterisk (*) may be sprouted to increase nutritional value. This increases by 10 times to 50 times the available vitamin content making product more completely digestible.
2. Items marked with "L" are for long storage (put them away and forget them).
3. Items marked "R" for rotational storage. To be continually used and replaced with fresh at regular intervals. (Many of these items could be bought hermetically sealed at a little greater cost and can be stored for a longer time.)
4. Items marked "S" are the most important foods. They should be stored together. These are the items you would pick up and run with. (I suggest these items should be sealed in 5 gallon cans. The cans will come in handy for carrying water, making camp stoves, reflector ovens, etc.)

5. The things marked "s" are the next important, bulkier and heavier, but very good. Take them if you possibly have room.

Start learning today to recognize edible plants and how to make traps to catch wild animals. (If not contaminated by radiation).

We have suggested here a preparation for a condition which we hope never comes to pass. But being prepared for it, if it does come, will be at a small cost in time, expense, and effort compared to the consequences that will follow unpreparedness.

May we all dedicate ourselves to every effort to prevent such a disaster. Let us use every ounce of our energy to learn true facts. Work with us to preserve the Constitution of the United States and have Communism and its attendant evils outlawed and banished from America. Let us keep our individual rights from being syphoned away by legislation (both local and national).

HOUSEHOLD GUIDE 1902

HEALTH IN VEGETABLES AND FRUITS.

Water cress is a remedy for scurvy.

Carrots for those suffering with asthma.

Asparagus is used to induce perspiration and purges the blood.

Turnips for nervous disorders and scurvy.

Spinach is useful to those suffering with gravel.

Lettuce is useful for those suffering from insomnia.

Blackberries as a tonic. Useful in all forms of diarrhea.

Cranberries for erysipelas are used externally as well as internally.

Bananas are useful as a food for those suffering from chronic diarrhea

Walnuts give nerve or brain food, muscle, heat and waste.

Pine kernels give heat and stay. They serve as a substitute for bread.

Apples supply the higher nerve and muscle food, but do not give stay.

Oranges are refreshing and feeding, but are not good if the liver is out of order.

Dried figs contain nerve and muscle food, heat and waste; but are bad for the liver.

Green water-grapes are purifying (but of little food value); reject pips and skin.

Blanched almonds give the higher nerve or brain and muscle food; no heat or waste.

Blue grapes are feeding and blood purifying; too rich for those who suffer from the liver.

Juicy fruits give more or less the higher nerve or brain, and some few, muscle food and waste; no heat.

Prunes afford the highest nerve or brain food; supply heat and waste, but are not muscle-feeding. They should be avoided by those who suffer from the liver.

Honey is wholesome, strengthening, cleansing, healing and nourishing.

Pieplant is wholesome and aperient; is excellent for rheumatic sufferers and useful for purifying the blood.

Lemons for feverish thirst in sickness, biliousness, low fevers, rheumatism, colds, coughs, liver complaints, etc.

Celery is invaluable as a food for those suffering from any form of rheumatism; for disease of the nerves and nervous dyspepsia.

Figs are aperient and wholesome. They are said to be invaluable as a food for those suffering from cancer. They are used externally as well as internally.

Salt to check bleeding of the lungs, and as a nervine and tonic for weak, thin-blooded invalids. Combined with hot water is useful for certain forms of dyspepsia, liver complaints, etc.

Fresh ripe fruits are excellent for purifying the blood and toning up the system. As specific remedies, oranges are aperient. Sour oranges are highly recommended for rheumatism.

Tomatoes are a powerful aperient for the liver, a sovereign remedy for dyspepsia and indigestion. Tomatoes are invaluable in all conditions of the system in which the use of calomel is indicated.

Raw beef proves of great benefit to persons suffering from consumption. It is chopped fine, seasoned with salt and heated by placing in a dish in hot water. It assimilates rapidly and affords the best of nourishment.

Peanuts for indigestion; they are especially recommended for corpulent diabetes. Peanuts are made into a wholesome and nutritious soup, are browned and used as coffee, are eaten as a relish, simply baked, or are prepared and served as salted almonds.

Eggs contain a large amount of nutriment in a compact, quickly available form. Eggs, especially the yolks of eggs are useful in jaundice. Beaten up raw with sugar are used to clear and strengthen the voice. With sugar and lemon juice, the beaten white of egg is used to relieve hoarseness.

Onions are almost the best nervine known. No medicine is so useful in cases of nervous prostration, and there is nothing else that will so quickly relieve and tone up a worn-out system. Onions are useful in all cases of coughs, colds and influenza; in consumption, insomnia, hydrophobia, scurvy, gravel and kindred liver complaints. Eaten every other day they soon have a clearing whitening effect on the complexion.

Apples are useful in nervous dyspepsia; they are nutritious, medicinal, and vitalizing; they aid digestion, clear the voice, correct the acidity of the stomach, are valuable in rheumatism, insomnia, and liver troubles. An apple contains as much nutriment as a potato in a pleasanter and more wholesome form.

How to Tell Contagious Diseases and How Long They are Infectious.

The following points will help to determine the nature of a suspicious illness:

DISEASE.	Rash or Eruption.	Appearance.	Durat'n in days.	Remarks.
CHICKEN-POX.	Small rose pimples changing to vesicles	2d day of fever or after 24h'r's illness..........	6–7	Scabs from about 4th day of fever.
ERYSIPELAS.	Diffuse redness and swelling................	2d or 3d day of illness..........		
MEASLES....	Small red dots like flea bites.............	4th day of fever or after 72 hours' illness.	6–10	Rash fades on 7th day.
SCARLET FEVER.	Bright scarlet, diffused	2d day of fever or after 24 hours' illness.	8–10	Rash fades on 5th day.
SMALL-POX..	Small red pimples changing to vesicles, then pustues	3d day of fever or after 48 hours' illness.	14–21	Scabs form 9th or 10th d'y, fall off about 14th.
TYPHOID FEVER.	Rose-colored spots scattered.......	11th to 14th day	22–30	Accompanied by diarrhœa.

DISEASE,	Symptoms appear.	Period ranges from	Patient is Infectious.
CHICKEN-POX....	On 11th day	10-18 days	Until all scabs have fallen off.
DIPHTHERIA	" 2d day	2- 5 days	14d's after dis'pear'ce of membr'ne
MEASLES*.......	" 14th day	10-14 days	Until scali'g and co'gh have ceas'd
MUMPS	" 19th day	16-24 days	14 days from commencement.
ROTHELN	" 14th day	12-20 days	10-14 days from commencement.
SCARLET FEVER.	" 4th day	1- 7 days	Until a scaling has ceased.
SMALL-POX	" 12th day	1-14 days	Until all scabs have fallen off.
TYPHOID FEVER	" 21st day	1-28 days	Until diarrhœa ceases.
WH'OP'G-CO'GH†.	" 14th day	7-14 days	Six wks. from beginning to wh'op

*In measels the patient is infectious three days before the eruption appears.

†In whooping-cough the patient is infectious during the primary cough, which may be three weeks before the whooping begins.

SANITATION ABOUT THE HOME.

Cleanliness.—The maxim "Health is wealth" is not appreciated as a truism; more frequently health is only prized as a blessing when it is wanting. The health of the household depends upon the scrupulous cleanliness of the premises more than upon any other one thing. The responsibility for this must largely rest with the house mother, she being the one usually more sensible of any needed change, and so the plainest and simplest expositions of sanitary science should be familiar to her.

Drains and Sinks.—The location of drains and sinks should be carefully considered and their condition frequently inspected. The drain pipe from a kitchen sink should lead for rods away from the house and let the outlet reach the roots of trees or shrubs which specially delight in moisture, as the willow or the quince. Never use an open box to convey any form of slops. Wood is often used as a conductor pipe, but in a short time it becomes thoroughly saturated with filth, and thus a breeder of disease and a menace to health. Tile is better than wood, and being porous, much of the moisture oozes out as it passes along.

Iron Pipes are good as long as they last, but will rust in the course of time. Lead is the best and most durable of all, but is also the most expensive. However, if the expense of a lead drainage pipe is set over against a doctor's bill and other expenses incident to sickness, it will be cheap in comparison, and who would consider it for a moment when weighed against the precious life of some member of the family.

Disinfectant.—Whatever material is used as a conductor, the drain should be flushed with some good disinfectant solution as often as once a week in warm weather. Copperas is as good as anything for ordinary use and has the advantage of being cheap. It can be procured of a druggist for about three or five cents a pound. Dissolve in the proportion of one-fourth of a pound to a gallon of water and use very freely. Plug the outlet and pour enough into the sink to fill the pipe its full length. Use the solution as near the boiling point as convenient, for the reason that a hot fluid is more penetrating than a cold one, an advantage if tile or wood is used. A hot solution is further advantageous as a solvent of whatever waste particles may have lodged at various points or gathered the length of the pipe. Dishwater usually contains more or less grease, and this will be melted and washed out if the disinfectant is poured in hot. Potash, sal-soda and lye may be used instead of copperas.

Refrigerators in which food is kept should be kept scrupulously clean and the pipe conveying the drippings from it should be entirely disconnected from the drainage system of the house. Milk and butter should not be placed near vegetables, especially those having a strong smell. Place a piece of charcoal in your refrigerator.

A Home Made Filter.—An eminent sanitarian, Dr. Parkes, has given directions for a home-made filter for drinking water. A large common flower-pot is covered over at the bottom, the opening and all, with a piece of clean flannel or of zinc gauze. Over this put a layer of coarse gravel about three inches deep, and over the gravel a layer of white sand of the same depth. Above the sand put four inches of charcoal, broken in fragments. If possible use animal charcoal. Lay over the top a clean, fine sponge that covers it, or if you have not a sponge, a layer of clean flannel. The top layer, whether of flannel or sponge, is to be made sterile by frequent washing and boiling. Set the filter in a wooden frame, and under it put a clean vessel to receive the water as it comes through the filter.

DISEASE GERMS IN DRINKING WATER, AND HOW TO COMBAT THEM.

1. Taking a little filtered beef bouillon, clear as crystal to the eye, and showing under the microscope not a trace of life, let us place it in a glass flask and, boiling it repeatedly to destroy any germs it may contain, set it aside in a warm place with the mouth of the flask open. In a few days the liquid previously so limpid becomes very turbid. If we take a drop and magnify it 1,000 diameters we shall see that the liquid is crowded with life, and the few ounces of bouillon contain a vaster population than our greatest cities can boast of.

2. Cohn has seen bacillus in infusions at blood heat divide every twenty minutes. We have calculated this rate for twenty-four hours, and have found that at the end of the first day there would be as the descendants of a single bacillus 4,722,366,482,869,645,213,696 individuals; and though we can pack a trillion (1,000,000,000,000) in a cubic inch, this number would fill about 2,500,000 cubic feet. This is clearly not what they do, but simply what they are capable of doing for a short time when temperature and food supply are favorable.

3. Since the multiplication of bacteria is so favored by the warmth of Summer, it requires special sanitary precaution, in order to keep free from disease.

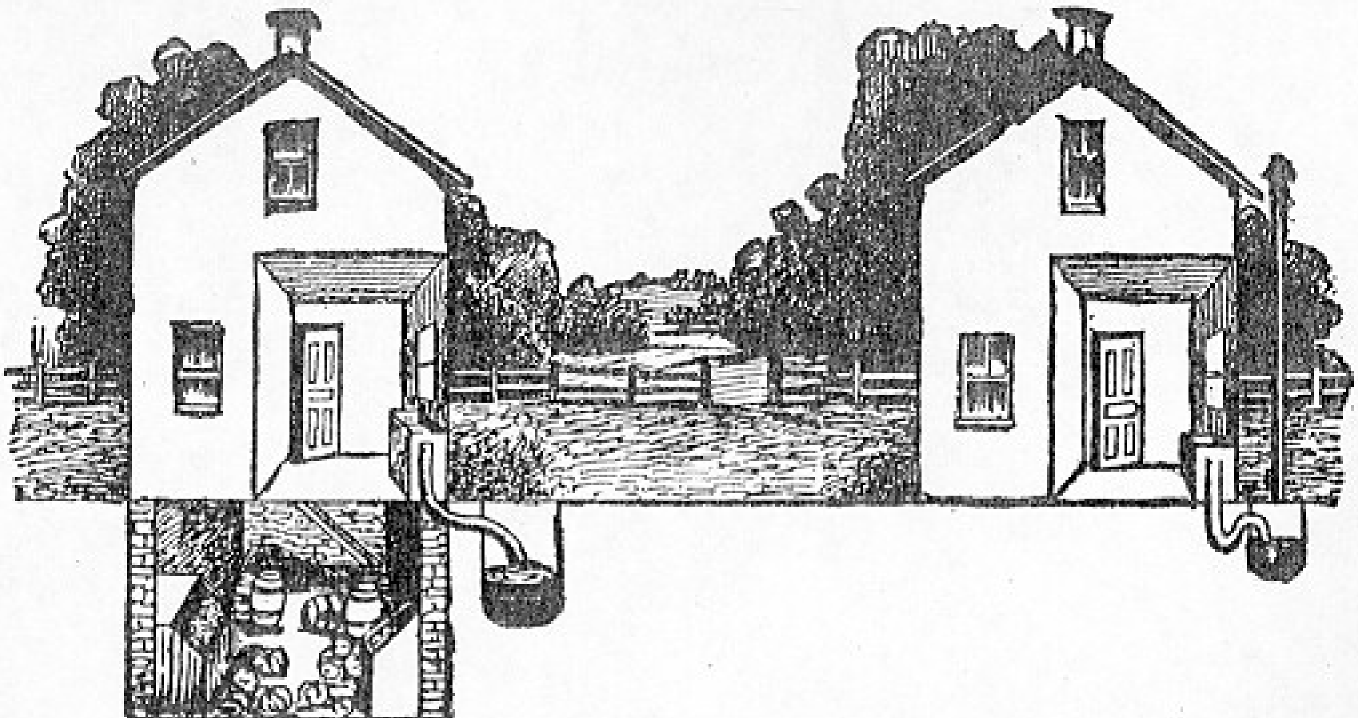
4. **Vegetable Refuse or Slop.**—If garbage and slops are thrown about the house, you can readily see what millions and myriads of bacteria will form, and how the whole ground will soon swarm with them. They will more or less work their way among the things that must be eaten, or if a heavy rain should come, will easily find their way into the well and contaminate the water. Malaria, typhoid fever, etc., will soon be the result.

5. **Sink Holes.**—There should be a sink hole for garbage, slops and other refuse matter of the house, and this sinck hole should be sufficiently far from the well, so as not to contaminate the water.

6. That sunshine is a germicide as well as a tonic has but recently been proved: if we take two flasks containing the bacillus with spores, and keep one in the direct sunshine for a long time, while the other, exposed to the same heat, is kept from the sun, we find the sun-exposed spores have lost their virulence, while the others remain. Is there need to further press so patent a lesson? As bacteria grow best in the presence of considerable moisture, we may expect to encounter them in greater abundance in water than in air. Rain water contains 60,000 to a quart, the Vanin four times as many, while the polluted Seine from 5,000,000 to 12,000,000.

7. **Remedy for Impure Water.**—The minute size of bacteria renders it very difficult to use any system of filtration and have pure water. If the water is impure there is but one absolutely safe method, and that is boiling.

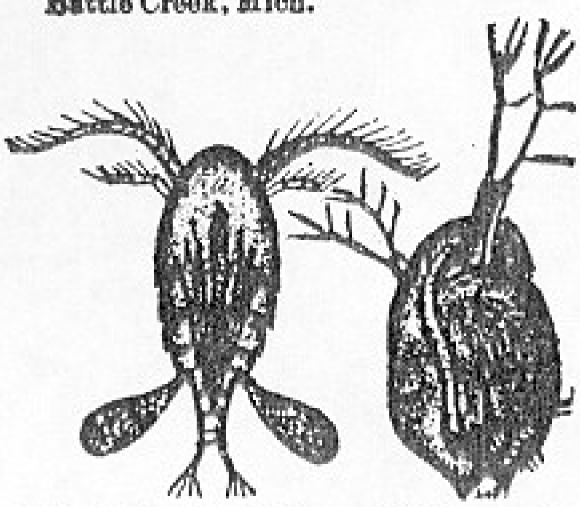
8. **Boiling Water.**—No disease germs producing bacteria can stand boiling for an hour or so. It destroys all vegetable and animal impurities. All doubtful water should be thoroughly boiled.



AIR CONTAMINATION.

The above cut is an illustration of a very common source of disease. At the left hand is shown a house, the inmates of which are being poisoned by destructive gases laden with disease germs which emanate from the cellar, in which may be seen bins and barrels of decomposing vegetables, and the cess-pool, filled with the accumulations of years The foul gases and germs from the cellar find ready access to the rooms above through the open cellar door, and from the seething cess-pool they ascend to the house through the untrapped drain pipe which communicates with the sink. At the right hand may be seen a house which is protected from cess-pool contamination by means of a trap in the drain pipe. As will be seen, the foul gases pass up through the ventilating pipe into the open air, instead of being drawn up into the house through the kitchen sink.

This cut is taken from *The Monitor of Health*, by permission of the publishers, Good Health Publishing Co., Battle Creek, Mich.



Animals that dwell in our drinking water.

THE ANIMALS WE DRINK IN OUR WATER.

The above illustration shows some of the animals we drink in impure water, which is a very prolific source of many diseases.

Thousands of wells are so situated that they receive a drainage from filthy and decomposing matter, or are polluted by slop holes' imperfect drains, that are too closely adjacent to the well.

Water from many of the wells is unfit for the human stomach, and some of them are as poisonous as Paris green. Impure water may be used for a time without any perceptible injury, but it is only a matter of time when it will develop into typhoid fever, diphtheria and many other diseases.

In either case, when well water is used, people should look the location over carefully, to see if the lay of the land is such as to allow decomposing matter from the surface of the ground or any other place to soak into the well. If this is the case, it should be abandoned at once if you value life, for it is positively known that thousands have lost their lives by using such water.

Every well should be laid up with brick or lime-stone and cemented about four feet from the surface. That will make a safe protection.

Heavy rain's will often cause water to flow into wells, which has a very bad effect, and often develops disease germs.

HOW TO DESTROY ALL KINDS OF HOUSE INSECTS.

1. Insects do not grow by imperceptible increase in size as a bird or a cat. All insects pass through several changes from the egg to the perfect state. The horrid caterpillar that crawls in our path today will soon be seen flitting among the flowers in the form of a beautiful butterfly.

2. To destroy house pests successfully, the history of the insect, from the egg to the perfect state, must be well known. The successful housekeeper must always be a close observer and a careful student in order to keep her house free from noxious insects.

HOW TO GET RID AND KEEP RID OF BEDBUGS.

1. The eggs of the bedbug are white in color and oval in shape. The young resemble the parents, and it takes about eleven weeks to get its full growth. Like reptiles, they can live many years without food. Mr. Goeze, of Germany, has kept them six years in a bottle without a particle of nourishment of any kind.

2. Keeping the bedding and bedstead perfectly clean is the best preventive.

3. **Remedy.**—Pour hot water into the crevices and then apply benzine to the different parts of the bedstead.

4. Unpurified petroleum mixed with a little water is also a sure remedy. Corrosive sublimate is a very good, but a very poisonous cure.

HOW TO KEEP OUT MOSQUITOES.

If a bottle of the oil of pennyroyal is left uncorked in a room at night, not a mosquito, or any other blood-sucker, will be found there in the morning.

A DOMESTIC REMEDY FOR DESTROYING FLIES.

½ tablespoonful black pepper, in powder,

1 teaspoonful brown sugar,
1 tablespoonful cream.

Mix them well together, and place them in the room on a plate, where the flies are troublesome, and they will soon disappear.

TO BANISH THE FLIES.

The following is vouched for: Take one ounce of camphor gum, one ounce of corrosive sublimate, one pint of oil of turpentine; grind the sublimate thoroughly, put into a strong bottle and add the camphor gum. Pour on the turpentine and shake occasionally. It should be fit for use in 36 hours. Heat a piece of iron and drop a few drops on it in the stable and all flies will leave. Flies may be driven out of the house by dropping a few drops on a hot stovelid. Practiced every other day will, it is said, soon drive out all flies.

A CURE FOR BEE AND WASP STINGS, SPIDER BITES, ETC.

Apply ammonia or common soda and water. If there is much inflammation and redness, apply a solution of borax and warm water. Apply with a rag saturated with the solution.

A NEW WAY OF TRAPPING ANTS.

1. Ants are very difficult pests to expel from the house. There have been many recipes and experiments tried, but without any satisfactory results.

2. The ants that infest our houses live only in rotten wood, either in the decayed sills of the house or in rotten timbers and old fences near by. It is best to remove all such hiding places if possible.

3. **Remedy.**—Ants are very fond of sugar, and anything containing it will attract them. Sweeten a pan of water to a thin syrup, and then dip a large sponge into it, and wring it out. Place the sponge where the ants can get at it; it will soon be filled through and through with ants, then take it up carefully and plunge it into boiling water, and again set it by saturating it with the thin syrup. A few days' trial will, for a long time, exterminate the annoying pests.

4. A trap more simple but not so effectual is a plate covered with a thin layer of lard and placed where the ants can easily get at it This trap is more to destroy the little yellow ant than the larger species.

HOW TO DESTROY ANTS.

Boiling water, kerosene, or a solution of fresh insect powder in water, poured into the hill, will destroy the inhabitants at once. Where the nests are outside of the house this is a sure remedy.

OTHER REMEDIES.

1. Cayenne pepper sprinkled in cupboards and storerooms will drive away ants and cockroaches. The pepper ought to be fresh and strong and very fine.

2. Black ants can be put to rout by washing shelves or floors whereon they congregate with hot water in which some ammonia has been dissolved.

3. Take five cents' worth of tartar emetic, mix it with an equal amount, in bulk, of soft or granulated sugar, put the mixture into dishes, keep it moist (quite moist), and set the dishes, one on each shelf where the ants appear, they will promptly take their departure. I do not know what becomes of them, but they are gone. I never find dead ones, either in the dishes or on the shelves. When not needed the dishes can dry out and be put away to be wet again for the next time.

4. You will find a most effectual remedy for the ant by mixing honey and insect powder and setting in shallow pan so that easy access may be had. The ants will come and partake in great numbers, never to return.

5. This is an effectual remedy for ants: In the center of a shallow dish put a very little Paris green, and on it a spoonful of honey—then pour in half a cupful of water. Set in their trail, and in a few days they will be gone. It is possible they will come again in a few weeks, but the second dose is effectual.

6. A sure way to keep the little common black ants out of food is to set the food on a board as large as desired, which is isolated by supporting the four corners in little tins of common insect powder. I drive a nail in each corner, letting it project say an inch, so as to form four legs, which I surround with insect powder either on the shelf itself or in little tin can covers which prevent the powder from getting brushed away. I never knew this plan to fail. A table or a cupboard may have its legs stand in dishes of powder. Borax, salt, kerosene, etc., are of no account in most cases. The kerosene soon evaporates and they will crawl right over the others. Pepper and camphor would be objectionable to have about. It's well enough to shoot powders into places like cracks where they come in, if you can find them and are willing to have the untidiness of it.

HOW TO PRESERVE BOOKS FROM BOOK MOTHS.

The little Bristle Tail or Silver Fish has a little, long, slender body covered with a delicate silver scale; it has no wings and passes through no changes. It feeds on the paste of the binding of books, devours leaves, eats off the labels in Museums and is generally destructive to both books and papers.

Books are also eaten by the larva of a little bug that produces a ticking sound like a watch—it is called the "Death Watch," as it is usually heard in the night ticking like a watch.

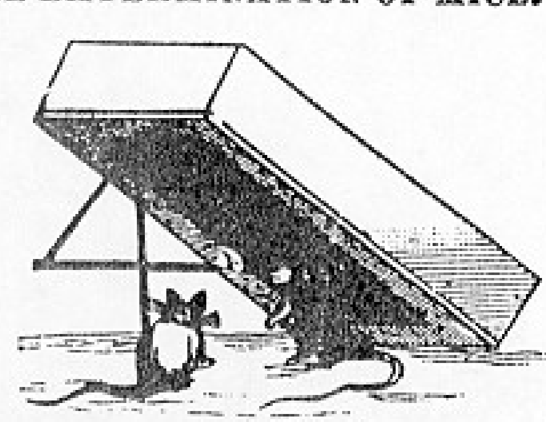
Remedy. A little rag saturated with benzine or carbolic acid placed along the back of the shelves will clear the library of all insects. Insect Powder sprinkled over the books will destroy the little "Silver Fish" insect instantly.

MIXTURE FOR DESTROYING FLIES.

1 pint infusion of quassia,
4 ounces brown sugar,
2 ounces ground pepper.

To be well mixed together, and put in small shallow dishes when required.

THE EXTERMINATION OF MICE.



1. The best and most careful trapper of mice will find great difficulty in capturing the shrewder and older

ones. They simply will not go into a trap. The best method for capturing those is illustrated in the above cut. Take a small box and fill it with brick or stones, and place under it a figure 4, baited with cheese, meat, or other attractive food, and as the box comes down it will destroy the sharpest and shrewdest mouse. By this method it is not difficult to keep rid of mice in any house.

2. Fill a sewing thimble with any eatable, as bread crumbs, pressed down tightly. Place the thimble under the edge of a good-sized bowl, with the open end inward. The mouse will nibble at the bread and the thimble will gradually work down and the mouse will be caught. The bowl should be put upon a loose board. The mouse can then easily be dispatched. This may seem too simple to try, but is very effective.

HOW TO POISON RATS.

1 qt. warm water, 2 lbs. lard, 1 oz. phosphorus.

Mix and thicken with flour; to be spread on bread and covered with sugar.

N. B.—Most of these patent preparations, such as "Rough on Rats," etc., for the extermination of rats and mice, are of little benefit. If they could be used when first prepared, they would be much more effective; but they are often kept in stores for months and years, and thereby lose all their strength.

A Sure Remedy.—It does not pay to try to raise rats and chicks in the same place; yet it is nearly impossible to keep the former down when farm buildings offer convenient hiding places. Various plans have been devised for dealing with this pest, with only partial success. A good method to get rid of a few rats is to slit a piece of fresh meat and fill it with powdered glass. Rats are very fond of wheat, and we have been quite successful with this method: Take 25 cents' worth of strychnine and dilute it with a cup of water (a quart bottle is a good article to use for this purpose). After the poison is dissolved add a few handfuls of wheat; set in a warm place, and when the wheat is swelled as much as possible scatter it in and around the rat-holes, or where the rats go. It is sure death to rats, cats, chicks or man. Be careful how you use it.

HOW TO GET RID OF RATS.

1. Common steel traps set in their holes or runways covered up with chaff or crushed dried leaves, will soon exterminate rats, or drive them from the premises.

2. To place the steel traps in pans of wheat-bran is a good device. After catching two or three rats in the same pan, leave out the trap a few nights, and then replace it.

3. Raw meat sprinkled with strychnine nailed to a small board, and placed as above, generally answers the purpose, unless the rats are very cunning, having been trapped and poisoned considerably.

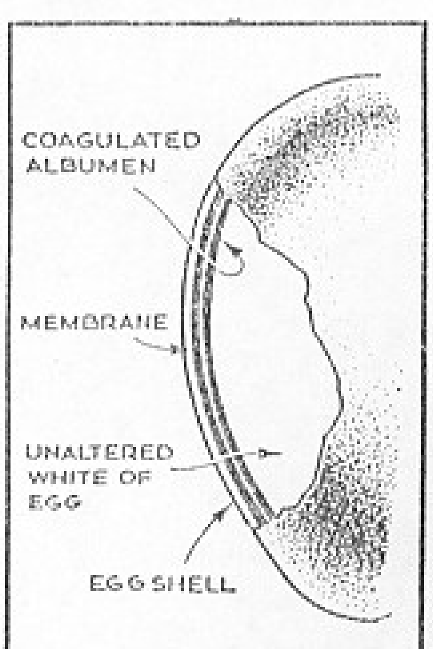
POPULAR SCIENCE July 1945

Eggs Are Preserved for a Year by Use of Flash Heat Treatment

EGGS remain in edible condition for as much as a year when given a flash heat treatment developed by Prof. Alexis L. Romanoff of Cornell University. The heat coagulates a very thin layer of outer albumen next to the shell, forming a thin inside coating that protects the contents.

Suitable for either home or commercial use and requiring only average kitchen equipment, the treatment consists of plunging the eggs into boiling water for five seconds, letting them cool, and putting them in a refrigerator. Prof. Romanoff found that eggs so treated still were in good condition a year later when kept in a refrigerator at 41 deg. F. Even when stored at room temperature of 70 deg. they stayed good for three months. In contrast, untreated cold-storage eggs as a rule remain edible for only about six months.

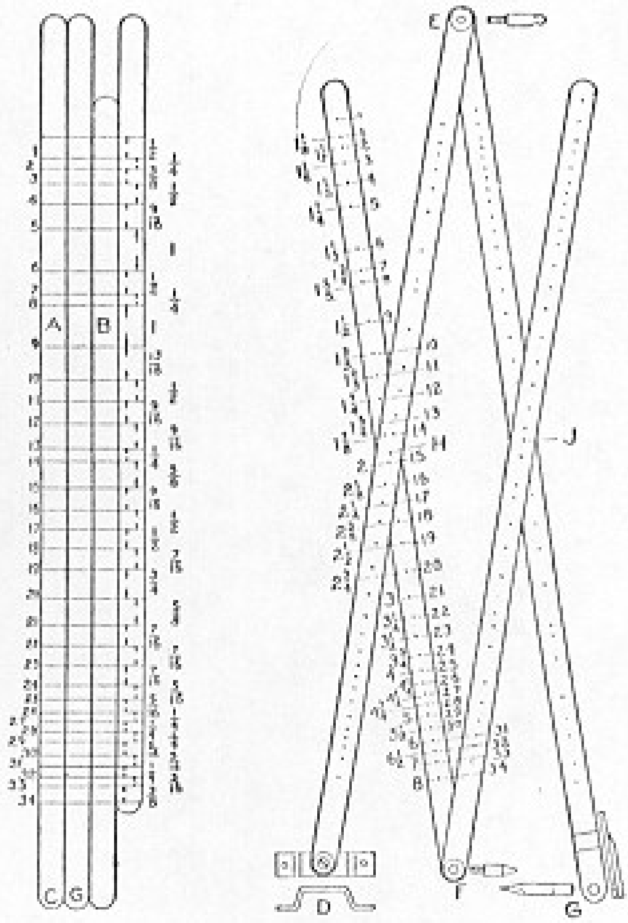
Fertile eggs hatch after the treatment, indicating that the nutritive value, flavor, and cooking characteristics are unimpaired. The stiffness of the albumen after beating, usually considered a criterion of storage eggs, is just about as good as that of fresh eggs.



Popular Mechanics — 1915

Homemade Pantograph

The pantograph consists of four pieces of wood, the dimensions depending somewhat on the size of the work to be drawn. A convenient size for ordinary drawing and enlarging is



A Picture can be Enlarged or Reduced by Setting the Screweyes in the Holes Designated

constructed of four pieces of hardwood, preferably maple, $\frac{3}{16}$ in. thick and $\frac{5}{8}$ in. wide, two of them $20\frac{3}{4}$ in. in length and the other two, $18\frac{3}{4}$ in. long. These are planed and sandpapered and the ends cut round.

All four pieces are laid flat on a level board or bench top with their edges together so that the edges of the two longer pieces make right angles with a line drawn tangent to their ends. One end of one short piece is placed flush with the lower ends of the two long pieces, and one end of the other short piece flush with the upper ends, as shown. They should be clamped down solidly to keep them from moving while laying off the divisions. Light lines are drawn across their faces as designated by the dimensions. On these lines and exactly in the center of the pieces make small marks with a pencil point. Through the pieces A and B holes are drilled to snugly receive the body of a small screweye. The other two pieces are drilled with a smaller drill so that the threads of the screweye will take hold in the wood.

The end C of the piece A has a metal stand made of brass as shown at D. This is fastened to the end of the wood with a small bolt. The hole should be a snug fit over the body of the bolt. The lower ends of the brass are drilled to admit thumb tacks for holding it to the drawing board.

The joint at E is made of a suitable binding post that can be procured at an electrical shop, the shank below the two joined pieces to be the same length as the height of the metal stand D. The end should be filed round and polished so that it will slip over the board or paper easily.

The stylus or tracing point F is made of another binding post, in the same manner, but instead of a rounding end a slightly blunt, pointed end is filed on it. The end of the piece G is strengthened by gluing a small block of the same material on both upper and under side. A hole is then made through them to receive a pencil rather tightly.

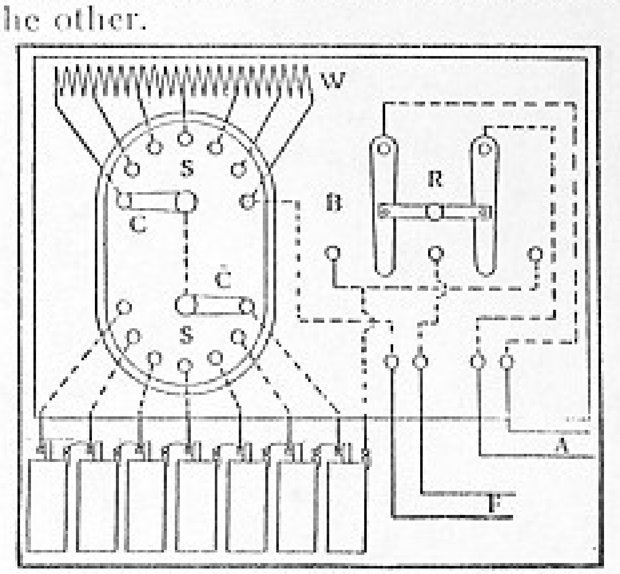
The holes, as will be seen, are numbered from 1 to 34. At the crossing of each pair, H and J, the screweyes must be set in the holes numbered alike on both pieces of each pair. This will insure the proper working of the parts. The other numbers designate how much the instrument will enlarge a picture or reduce it. On the pair not numbered in the sketch the numbers run in the opposite direction.

The end C is fastened to the left side of the drawing board, the picture to be enlarged is placed under the stylus or tracer point, and the paper under the pencil point G. Move the tracing point over the general outline of the picture without making any line before starting, so as to make sure that the paper and picture are located right. It is then only necessary to take hold of the pencil and move it over the paper while watching the tracer point to keep it following the lines of the picture. To make a reduced picture, the original is placed under G, the tracer point changed to G and the pencil to F.

Popular Mechanics — 1913

A Controller and Reverse for a Battery Motor

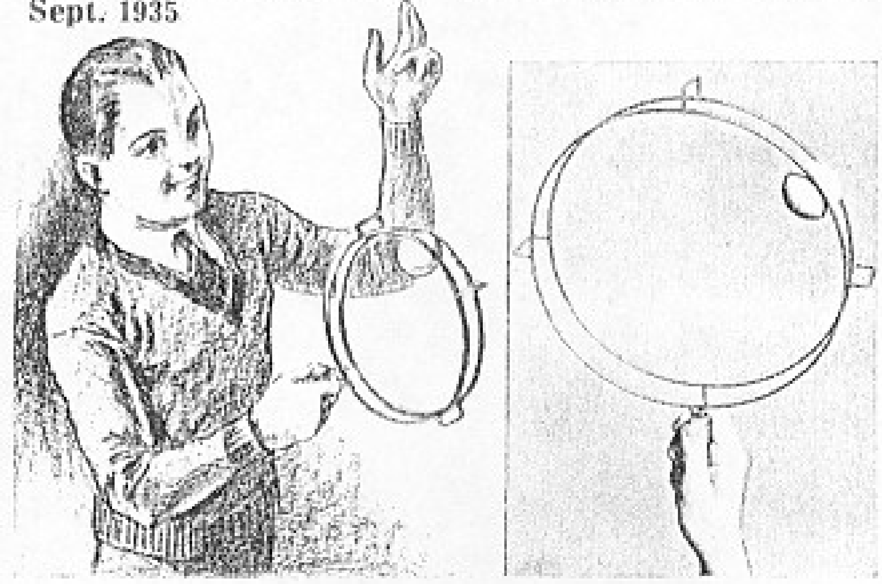
Secure a cigar or starch box and use to make the base, B. Two wood-base switches, S S, are cut off a little past the center and fastened to the base with a piece of wood between them. The upper switch, S, is connected to different equal points on a coil of wire, W, while the lower switch, S, is connected each point to a battery, as shown. The reverse switch, R, is made from two brass or copper strips fastened at the top to the base with screws and joined together by a piece of hard rubber or wood with a small handle attached. Connect wires A to the armature and wires F to the field of the motor. By this arrangement one, two or three and so on up until all the battery cells are used and different points of resistance secured on the coil of wire. The reverse lever when moved from right to left, or left to right, changes the direction of the armature in the motor from one way to the other.



Motor Reverse and Controller

Popular Science Monthly Sept. 1935

BALL LOOPS THE LOOP IN NEW TOY



When the handle is manipulated, the ball does surprising tricks

Quickness of eye and muscle are called for by a new toy just introduced to the public. It consists of two parallel loops of wire and a handle by which the user causes a soft rubber ball to roll along the circular track. With comparatively little practice, according to the maker, anyone can perform a variety of tricks, making the ball loop the loop and execute many seemingly difficult evolutions.

Mrs. Curtis' Cookbook 1908

CEREALS AND FLOUR PASTE (MACARONI)

CEREALS include the grain foods from cultivated grasses, containing every variety from oatmeal to macaroni, which is a paste made of wheat flour rich in gluten. Among them are most valuable foods—rice, for instance, which is the staff of life for certain nations. In what we call breakfast cereals we have a number of foods that are unusually rich in nitrogenous matter and mineral substances, therefore making an excellent morning meal with no further addition than milk or cream, for all cereals are lacking in fat. Unless cereals can be subjected to the long, slow cooking which is necessary, they had better not be eaten, for nothing is so indigestible as half-raw oatmeal. Twenty years ago, when most of our oatmeal was the old-fashioned steel-cut oats, it needed interminable cooking—ten hours was none too long for it; to-day most of the cereals put up in packages, so the directions say, can be cooked in half an hour. That is not possible; few of them, except the fine-grained wheat foods, are fit to eat till they have had at least one hour's cooking in a double boiler. If they can have longer, they are so much the better. Always add the proper amount of salt to a cereal—1 teaspoonful to a quart of water—and let it dissolve before the grains are put in, so it will flavor the whole mass. The best way to cook any rough-grained cereal is to drop it slowly into water which is boiling briskly in the upper part of a double boiler. After cooking for a few minutes on the stove, set it over the water and allow the grains to swell slowly so the food is stiff enough to be chewed. Cornmeal demands a long time for cooking—at least six hours—and it swells so it should have six times the same measurement of water. Granular cereals, farina, for instance, should be mixed with a little cold water and stirred smooth before being added to the necessary amount of boiling water; this prevents it from becoming lumpy. Never stir any cereal after it has been put to cook, until just before it is turned out. This treatment makes oatmeal pasty and sticky. Store cereals in glass cans with tight-fitting lids instead of the pasteboard boxes in which they are sold. It keeps them fresher and safe from the invasion of moths or mice.

Cereal with Fruit.

$\frac{3}{4}$ cupful wheat germ,
$\frac{3}{4}$ cupful cold water,
2 cupfuls boiling water,
1 teaspoonful salt,
$\frac{1}{2}$ pound dates, stoned and cut in pieces.

Mix cereal, salt, and cold water; add to boiling water in a saucepan. Boil five minutes, steam in double boiler thirty minutes; stir in dates, and serve with cream. Serve for breakfast or as a simple dessert.—FANNIE M. FARMER.

Oatmeal Porridge.

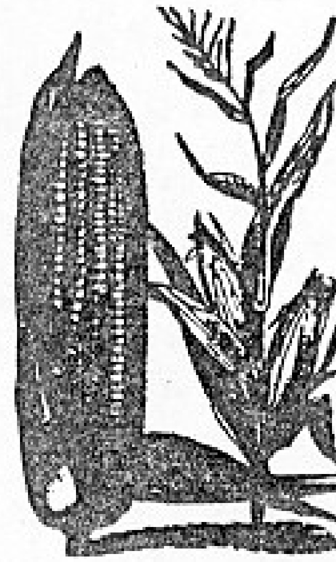
1 cupful granulated oatmeal,
1 teaspoonful salt,
1 scant quart boiling water.

Put the oatmeal and salt in a double boiler, pour on the boiling water, and cook three or four hours. Remove the cover just before serving and stir with a fork to let the steam escape. If the water in the boiler be strongly salted, the oatmeal will cook more quickly.

Hasty Pudding.

1 cupful cornmeal,
2 tablespoonfuls flour,
1 teaspoonful salt,
1 cupful milk,
2 cupfuls boiling water.

Mix the meal, flour, and salt with the milk; when smooth, stir in the boiling water. Cook in a double boiler one hour or more; or over direct heat one half hour. Serve with cream and sugar, or turn into tins to cool if wanted for sautéing. Cut into slices, dip in flour, and sauté in drippings or butter.



Hominy Mush.

$\frac{1}{2}$ cupful fine hominy,
$\frac{1}{2}$ teaspoonful salt,
3 cupfuls boiling water.

Put all together in a double boiler, and cook three hours. Add more water if mush seems stiff; all preparations of corn absorb a great deal of water in cooking, and hominy usually needs a little more than four times its bulk.

Rolled Oats.

1 cupful rolled oats,
$2\frac{2}{3}$ cupfuls boiling water,
$\frac{1}{2}$ teaspoonful salt.

Mix ingredients, and cook in double boiler one hour.

Steamed Rice.

1 cupful rice,
1 teaspoonful salt,
3 cupfuls boiling water.

Pick over the rice and wash in three or four waters. Put it with the salt and boiling water in upper part of double boiler. Cook over boiling water. Do not stir while cooking. Steam until the grains are tender.

Boiled Rice.

$\frac{1}{4}$ cupful rice,
1 teaspoonful salt,
4 cupfuls boiling water.

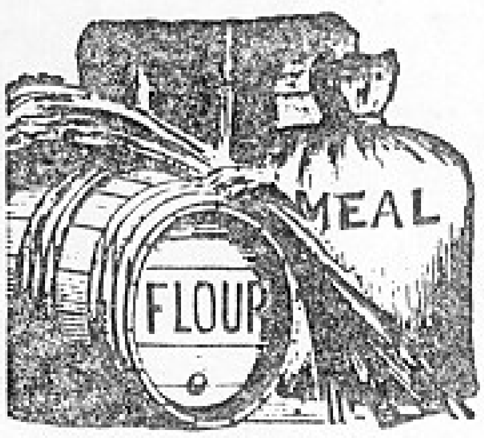
Wash rice thoroughly and gradually add to boiling water, care being

taken that the water does not stop boiling. Cover and cook twenty minutes, or until grains are soft. Turn into a strainer and drain, put in oven a few moments to dry, with oven door open.

Turkish Pilaf.

- ½ cupful rice,
- ¾ cupful tomatoes, stewed and strained,
- 1 cupful brown stock, lightly seasoned,
- 3 tablespoonfuls butter.

Add tomato to stock, and heat to boiling point; add rice, and steam till soft; stir in butter with a fork, and keep uncovered that steam may escape. Serve in place of a vegetable, or as a border for curried or fricasseed meat.—Fannie M. Farmer.



Rice Timbales.

- 1 cupful rice,
- ½ teaspoonful salt,
- 1 egg,
- 1 teaspoonful butter.

Place the rice in a double boiler over the fire, cover with cold water, boil five minutes, then drain it on a sieve, rinse off with cold water, return to saucepan again, cover with ½ pint water, add the salt and boil till tender; add the egg and butter to the mixture, fill the rice in small timbale forms, set them in a pan of water so the water reaches halfway up the forms, place the pan in a hot oven, and bake ten minutes. Unmold and set the timbales in a circle.

Rice à la Creole (Southern recipe).

- 1 onion,
- 1 slice cooked ham,
- 1 tablespoonful butter,
- 1 cupful cooked rice,
- 1 can tomatoes,
- 1 teaspoonful salt,
- Dash of McIlhenny's Tabasco Sauce.

Chop the onion and ham fine; put in a saucepan with the butter; add the rice and tomatoes, salt, and paprika. Mix and heat thoroughly. Then put in a baking dish, cover with bread crumbs, and put in the oven for fifteen minutes. The tomatoes should be stewed until thick before mixing.

Manana Land (Mexican recipe).

- 1 tablespoonful olive oil,
- 1 sliced onion,
- 8 green peppers,
- 1 cupful uncooked rice,
- ½ can tomatoes.

Fry in the olive oil the onion and green peppers, chopped fine; to this add the uncooked rice, and stir constantly until the rice is nicely browned; then put in the tomatoes, fill up the skillet with rich soup stock, and cook slowly, without stirring for an hour.—May E. Southworth.

Rice Milanaise Fashion.

- 1 cupful rice,
- 2 tablespoonfuls butter,
- 1 onion,
- 1 quart stock,
- 1 teaspoonful salt,
- 2 tablespoonfuls butter,
- ½ cupful grated cheese.

Cook the rice in a quart of cold water, stir until the boiling point is reached, and let boil three or four minutes, then drain and rinse in cold water and turn on a cloth to dry for a few minutes. Put the butter into a stewpan; cook in it until softened and slightly yellowed, a slice of onion chopped fine; then add the rice and stock and salt; cook until the rice is tender and the liquid absorbed; add the butter and grated cheese. Lift the rice with two forks to mix the butter and cheese evenly. Vary the dish occasionally by adding a cup of strained tomato with the broth and two tablespoonfuls chopped green pepper with onion.

Spaghetti à la Italien (Neapolitan recipe).

- ½ cupful dried mushrooms,
- 1 tablespoonful butter,
- 1 onion,
- 1 clove garlic,
- 1 pound chuck steak,
- 2 slices bacon,
- 1 cupful tomatoes,
- Salt,
- Paprika,
- Pepper,
- 1 package spaghetti.

Soak the mushrooms in a cup of tepid water for fifteen minutes; put the butter into a frying pan; when melted, add the onion and garlic, cut fine. Let this cook to a straw color, then add the meat and bacon, cut into finger lengths. Let this cook about five minutes, add the tomatoes and simmer slowly for about fifteen minutes. Then add the mushrooms, together with the water in which they have been soaked. Season very lightly with salt, pepper, and paprika. Let this simmer slowly for an hour and a half. During this time cook the spaghetti in about 2 quarts boiling water to which 2 tablespoonfuls salt have been added. Cook twenty minutes, then pour in a colander and blanch with warm water. When the sauce has cooked sufficiently, take a large platter, spread half of the spaghetti upon it, and pour over it some of the sauce. Now sprinkle upon this grated cheese. Add the remainder of the spaghetti, finish with sauce and cheese, and serve.

Macaroni Siciliana (Italian recipe).

- 1 onion,
- 1 carrot,
- 1 tablespoonful butter,
- 2 pounds beef,
- 1 quart tomatoes,
- Bay leaf,
- 3 cloves,
- 1 pound macaroni,
- 1 pound grated Swiss cheese.

Slice very thin the onion and carrot; put in a pot with the butter and let it fry, then put in the beef that has been cut in thick slices. Stir until it has browned nicely, add the tomatoes, bay leaf, clov peppers to ta

hours or more, till the sauce gets thick. Strain through a sieve until the sauce is free from the meat. Take the macaroni and boil for twenty minutes, salt to taste. Drain off the water, and put it in a large, deep dish; pour over it the sauce and put in grated cheese. Mix all thoroughly, and serve hot.

Macaroni Ravioli (Italian recipe).

½ package macaroni,
½ Parmesan cheese,
2 tablespoonfuls butter,
12 chicken livers (parboil),
2 stalks celery,
1 onion,
½ carrot,
½ turnip,
Pepper and salt.

Mince the livers and vegetables fine, and put them in a saucepan to cook in a little butter. Blanch the macaroni; add pepper and salt and let it drain. Lay some macaroni in a baking dish, then a layer of the liver and vegetables, then the cheese, and so on till the dish is full enough. End with a layer of cheese. Set the dish in the oven and let it cook for a few minutes. Brown on top and serve very hot.

Macaroni à la Napolitaine (Italian recipe).

1 pound macaroni,
1 tablespoonful butter,
1 onion,
4 tablespoonfuls grated Parmesan cheese,
Pepper and salt,
1 cupful cream.

Put the macaroni into boiling water, add butter, salt, and onion stuck with cloves. Boil for three quarters of an hour; then drain the macaroni and put into a saucepan with cheese, nutmeg, salt, and cream. Let stew gently a few minutes, and serve very hot.

Macaroni with Tomatoes.

Break half a pound of macaroni into inch lengths and boil in salted water until tender. Drain, and put a layer of the macaroni in the bottom of a greased pudding dish, sprinkle with pepper, salt, onion juice, and grated cheese. Cover all with a layer of stewed and strained tomatoes that have been previously seasoned to taste. On these goes another layer of macaroni, and so on till the dish is full. The topmost layer must be of tomatoes sprinkled with crumbs and good-sized bits of butter. Set in hot oven, covered, for twenty minutes, then bake, uncovered, until the crumbs are brown.—

MARION HARLAND.

Spaghetti with Cheese.

½ pound spaghetti,
½ cupful Swiss cheese,
3 tablespoonfuls melted butter,
Dash McIlhenny's Tabasco Sauce.

Break the spaghetti into bits and boil in salted water. Grate the cheese and turn into a saucepan with the butter. Stir well, add the hot spaghetti; just long enough to melt the cheese; add tabasco, and serve very hot.

Spaghetti with Chicken.

½ package spaghetti,
2 cupfuls chicken stock,
1 tablespoonful flour,
1 tablespoonful butter,
1 cupful cold chicken,
1 egg.

Boil the spaghetti until tender; drain, drop in cold water, and drain again. Cut into half-inch pieces.

Thicken the stock with flour and butter. Stir in the chicken chopped fine and macaroni. Beat in the egg, whipped, remove from the fire, season to taste, turn into a buttered dish, sprinkle crumbs over the top, and bake half an hour.

Spaghetti Piquante.

½ pound spaghetti,
1 teaspoonful butter,
1 teaspoonful flour,
2 cupfuls beef stock,
4 tablespoonfuls tomato catsup,
6 drops McIlhenny's Tabasco Sauce,
1 teaspoonful kitchen bouquet,
Pinch salt,
Dash paprika.

Break spaghetti into small bits. Boil until tender, in salted water. Drain and keep hot while you make the following sauce: Cook together the butter and flour; when blended pour the stock and stir until smooth, then add the catsup, tabasco, kitchen bouquet, salt, and paprika. Turn the spaghetti into this sauce, stir and pour the mixture into a dish. Sprinkle buttered crumbs and grated cheese over the top, and bake till brown.

Entrades (Mexican recipe).

¼ cupful olive oil,
2 tablespoonfuls butter,
2 green onions,
1 spray parsley,
1 stalk celery,
1 leek,
½ garlic,
1 green pepper,
1 teaspoonful salt,
1 tablespoonful Spanish sausage,
½ cupful stock,
½ package macaroni,
Edam cheese.

Make a sauce of olive oil and butter heated together; in this fry the onion, parsley, celery, leek, garlic, pepper, all chopped fine. Season with salt and the sausage. After it is well cooked down, add the stock. Boil the macaroni until tender, then plunge in cold water to blanch. Place on a large platter, strain the hot sauce over it, and cover the top with grated cheese.—MAY E. SOUTHWORTH.

Baked Macaroni.

½ pound macaroni,
1 quart stock,
1 tablespoonful butter.

Break the macaroni into inch lengths. Boil till tender in stock. Drain, put the macaroni in a dish; pour over it ½ cupful stock in which it was cooked, add the butter, in small pieces, here and there through it. Sift over it fine bread crumbs and grated cheese. Dot with bits of butter and brown.

Oatmeal.

½ teaspoonful salt,
1 cupful oatmeal,
4 cupfuls water.

Put the boiling water a granite pan, salt it, then scatter in the oatmeal. Allow it to cook six minutes, stirring steadily. Into the fireless cooker saucepan set the oatmeal dish, cover with a plate, and pour in boiling water to surround it till it almost reaches the top of dish. Cover, set on the stove and let the water boil five minutes, then place in the fireless cooker and leave there for five hours, or if required for breakfast, till morning. If it is not quite hot enough, set the cooker saucepan on the stove and let the water in the other vessel boil for a few minutes; then serve.

Quaker Oats.

2½ cupfuls boiling water,
1 teaspoonful salt,
1 cupful Quaker oats.

Cook in exactly the same way as oatmeal.

Indian Meal.

3½ cupfuls water,
1 teaspoonful salt,
1 cupful cornmeal.

Bring the water to a boil, stir the meal slowly into it, being careful that it does not lump. Boil half an hour, stirring frequently, set into the saucepan of cooker with water around it and leave it over night.

Cream of Wheat.

2¼ cupfuls water,
½ teaspoonful salt,
½ cupful cream of wheat.

Prepare after the same fashion as oatmeal, and give four hours in the fireless cooker.

Cracked Wheat.

4 cupfuls cold water,
1 cupful cracked wheat,
1 teaspoonful salt.

Pour the cold water over the wheat and let it stand six hours. Put it in a granite pan as used for oatmeal and set it on an asbestos mat over the fire, allowing it to cook and swell for two hours, stirring occasionally. Cover closely, set into the fireless-cooker saucepan, pour boiling water around it, let it boil up, then put into the cooker and allow it to stand over night.

Fine Hominy.

4 cupfuls water,
1 cupful hominy,
1 teaspoonful salt.

Treat this cereal in the same fashion as others, leaving in the cooker over night.

Preservation and Canning Fruit and Vegetables

CANNED GOODS FOR THE MARKET—UTENSILS AND MATERIALS—THE PROCESS—PRESERVES AND PRESERVING—SMALL FRUITS—LARGE FRUITS—PURÉES AND MARMALADE—JELLY MAKING—CANNING VEGETABLES

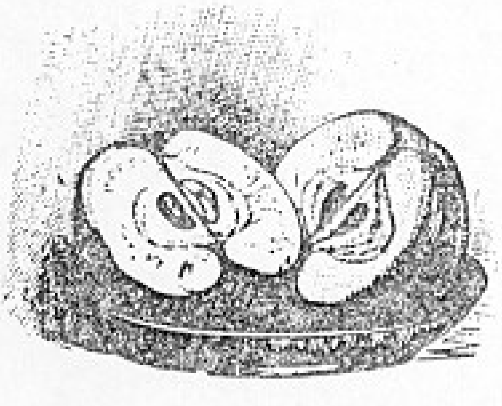
The art of preserving and canning fruit and fresh vegetables is much more important than is usually realized. Preserved fruit is, perhaps, most often classed with candy and other sweetmeats as an expensive luxury. But fruit, properly put up, is not necessarily expensive and may be regarded as a very essential part of the diet in winter. The value of fruit as food can hardly be overestimated. The fruit juices have a peculiarly wholesome effect upon the digestive organs and tend to keep the blood in good condition. They also, to a large extent, prevent the necessity for cathartic medicines. Fresh fruit in season should, of course, have the preference, but in winter properly canned fruit and preserves may take their place with almost equally good effect.

The art of canning fresh vegetables in the kitchen has now been so perfected that most kinds of garden truck may be canned without expense other than for jars, labor and fuel. All housewives who have not yet attempted this newly devised process will be delighted to discover that they can easily preserve such garden vegetables as early peas, sweet corn, and others, and serve them in midwinter with all their original delicacy of texture and flavor. The value of such a contribution to the winter diet is apparent. It not only adds to the palatability, æsthetic value and wholesomeness of the diet.

It is also an important measure of economy, since by this means any surplus of garden products, which would have little or no value in summer, may be preserved for use during the period of greatest scarcity and consequent high prices.

Preserving and Canning. — These terms are used somewhat loosely, but the word preserves more properly applies to the old-fashioned method of our grandmothers, which consisted in boiling the fruit in sirup after the

time-honored recipe of "pound for pound." This process, to be entirely successful, is difficult and tedious. It is also expensive on account of the amount of sugar required. The old-fashioned preserves are still favored by some, but the easier, quicker and cheaper method of canning has largely deposed them. The term "preserves" also covers jams, or purées, and marmalade, which are fruit, or mixtures of fruit, stewed to a smooth paste.



CANNED GOODS FOR MARKET

Money in Preserving Fruit.—In addition to the importance of preserving fruit and vegetables for home use there is a large and constantly increasing market both locally and in the large cities for a fine grade of homemade canned products. Prices ranging from seventy-five cents to $1.50 per quart, at retail, for a high grade domestic article are not infrequent. After deducting the cost of fruit, or vegetables, sugar and other materials including jars, rings, bottle wax, labels, the cost of packing and transportation, and the labor cost (at a nominal figure, say, ten or fifteen cents an hour) for all time actually engaged in picking the fruit, preserving and packing it, there should be a profit of at least 100 per cent clear to the maker. And after a reputation has been established for a product of uniformly high quality, even better prices can be realized.

This is not only a practical way for any housekeeper to earn extra pin money. In many localities it is the only feasible method of marketing the fruit and truck crop.

Ordinarily so much produce ripens at about the same time in villages and rural communities, that there is no sale for it at any price. And the comparatively small amount grown by one family, together with the distance to the nearest market, often makes it unprofitable to pack and ship the produce as it ripens to a commission merchant. But the smallest quantities can be gathered and canned from day to day during the season. Thus a sufficient quantity can be accumulated to justify the time and cost of packing and shipping by freight to the nearest city.

Or if the quantity is large enough, it may be worth while to make a trip in person, taking a sample of the product, in order to make an advantageous sale to some large consumer. Commission merchants and wholesale grocery houses are usually glad to buy, at fair prices, all the homemade goods of this sort they can obtain. But the stewards of the finest hotels and clubs, such as the country clubs that are springing up all over the United States, will often pay fancy prices for an especially fine article.

Even local merchants have a considerable demand for these goods and will sometimes make a special effort to sell them for a good customer. Or orders can be secured from neighbors by means of an advertisement in the local paper or by tactful solicitation.

The principal difficulty met in the sale of homemade goods is the common belief among merchants and others that they may not be of uniformly high quality. Factory-made goods are nowadays done up with scientific care and accuracy. The jars are carefully inspected and the contents very rarely mold or sour.

Unless one is willing, therefore, to take every step with the most rigid and painstaking thoroughness, it is useless to attempt to compete with the factory product. But once a well-deserved reputation has been built up, a demand will have been created for all that one will ordinarily wish to supply.

Many women earn a living for themselves or contribute largely to the family income by thus creating a market for all the produce that their husbands can grow. Many others find it profitable to buy fruit and vegetables from their neighbors, employ and carefully train assistants and put up hundreds of dollars' worth annually.

To Pack Canned Goods for Market.—Use only the best quality of all-glass jars. Do not attempt to economize on labels, but obtain the most attractive that money will buy. A distinctive label is an immensely important point in promoting sales and building up a reputation for one's product. Cement the labels neatly and securely in a uniform position on the jars. Wrap each jar in stout colored wrapping paper, fold and seal top and bottom with mucilage, or by means of a label gummed over all, and place a label on the outside of the wrapper in addition to that on the jar itself.

The best method of packing is to obtain from a dealer cylinders of the proper size which are made for this purpose of corrugated cardboard. Obtain also a supply of the same cardboard to place between the layers of jars. If your annual output is large enough, suitable cases to hold a quarter gross or half gross of jars can be made at home, or for a trifle by a local carpenter. These will be returned by the purchaser on request.

Or the jars may be packed in stout packing cases or barrels and surrounded with excelsior, straw or hay. An excellent method is to place between two sheets of thick manila paper a layer of excelsior and stitch or quilt the whole together at intervals with long stitches such as are used in basting. The whole may then be cut with shears to proper lengths, between the rows of basting. In these wrap up the separate jars. Also line the box or barrel with them and place one or more thicknesses between the different layers of jars. In addition crowd excelsior between the jars so that no two jars can come into contact.

If packing cases are used, the excelsior must be crowded in at the top so that the contents cannot move, and the lids securely nailed on. It is easy to ascertain by shaking it vigorously whether the case has been solidly packed. If any rattling is heard, it should be opened and repacked.

If barrels are used, it is sufficient to take off the top hoop and cover the top with a piece of canvas or burlap. Replace the hoop over the cloth and put on the top a stout label marked "Glass, This Side Up, With Care." Better care is given a package thus left without a head than to a sealed box or barrel. Place even dozens in each package, and be sure to make an accurate

count. Have a printed billhead and promptly notify the consignee of the time of shipment by mailing the bill with a courteous note.

To Fix a Price on Canned Goods.—Keep account of all time taken in picking, preserving or packing the produce and figure out what it would cost you to hire the work done by ordinary day labor. Usually ten or fifteen cents an hour is a fair figure. Add to this the cost of the produce and sugar actually consumed, jars and all accessories, including packing material, labor, etc. When you have thus arrived at the actual cost including labor, double this amount to allow yourself 100 per cent profit. If at first you are unable to sell your goods at this price or better, it is probably because you are inexperienced. Either you are not taking advantage of the work, or others are taking advantage of you in the price you are paying for labor or material. But 100 per cent profit is the ideal you should have in view, and some persons making homemade canned goods realize two or three times as much on their investment.

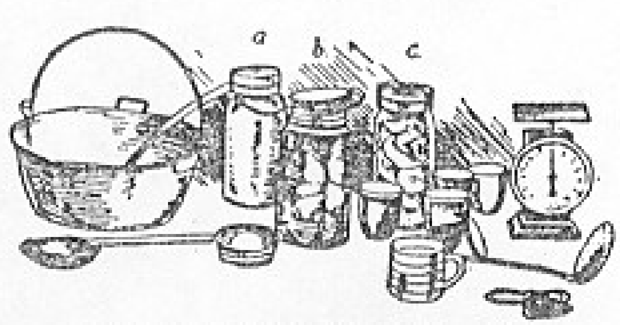
Storing Preserves.—Canned vegetables, fruits and preserves should be stored in a cool, dark, dry place. The cellar is not the best place unless it is dry and well ventilated. A storeroom partitioned off from the cellar and built of concrete is an ideal apartment for this purpose. In houses that are heated in winter, a dark, airy closet in the upper part of the house is a good place. But of course, they must not be placed where they will freeze in cold weather. If it is necessary to store them in an ordinary cellar to prevent freezing, a swinging shelf should be constructed for this purpose. The jars should be allowed to become stone cold before being stored away. They will keep much better if carefully wrapped in dark-colored paper folded and pasted top and bottom, and labeled on the outside so that it will not be necessary to disturb the wrappers until they are required for use.

UTENSILS AND MATERIALS

Utensils for Canning.—The most useful utensil for canning in considerable quantities is an ordinary tin wash boiler, such as is used in the laundry, cut down to convenient size.

"A Utensil for the Ordinary Range."

As this utensil will not ordinarily have a great deal of wear, a cheap tin wash boiler may be purchased, or an old wash boiler that has been discarded may, by means of patches and solder, be put into sufficiently good order to answer this purpose. Measure from the bottom of the wash boiler to a point four or five inches higher than the top of an ordinary quart fruit jar, mark a line all around at this point, and have a tinsmith cut it off on this line. Or you can cut it off yourself with a chisel and hammer by inserting the end of a block of wood and striking against this. But it is better to have this work done by a tinsmith, and have him turn over the sharp edge so that you will not cut yourself on it. Now have a gridiron of wooden slats or wires fitted into the bottom in the

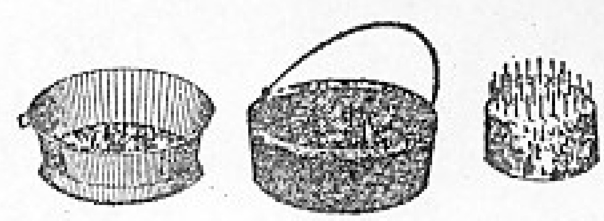


"A Large Porcelain Kettle."

inside. This is to keep the jars off the bottom on the principle of the double boiler. The result is a utensil of the right size for use on an ordinary range or on two burners of a gas or alcohol stove, and of convenient depth for sterilizing jars as well as canning the produce.

Or use an ordinary wash boiler fitted with a suitable false bottom. This has the same advantages, except that it is less convenient to reach into its steaming depths when removing the jars.

A large porcelain preserving kettle holding ten or twelve quarts, a porcelain skimmer and ladle and a long-handled stirring spoon of wood are also necessary. A pair of scales and suitable measuring cup should always be at hand in the kitchen. The old-fashioned Mason jar is still in use, but the so-called lightning jar is preferable. Have on hand a sufficient quantity of new rubber rings. Never attempt to use old rings, as rubber decays very rapidly, and the old ring is almost certain to admit the air into the jar, causing the contents to spoil before it is used. Old rings also harbor bacteria that cause fermentation. With clean jars and new rubber rings, the battle is already half over. Other useful devices in canning, preserving and jelly making are the sugar gauge, fruit pricker, ordinary wooden vegetable masher, wire sieve or colander and wire basket such as are shown in the accompanying illustrations.

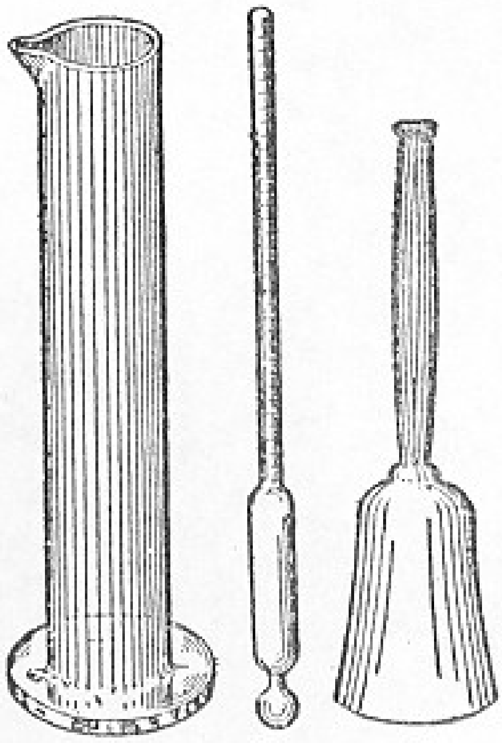


a b c
(a) Wire sieve; (b) wire basket; (c) fruit pricker.

To make a fruit pricker cut a piece one-half inch deep from a broad cork, press through this a dozen or more coarse darning needles and tack the cork on a piece of board. One stroke on this bed of needles punctures the fruit with a dozen holes. But be sure to use large, strong needles and take care that none of the points are broken off and remain in the fruit. Remove the cork from the board, and wash and dry thoroughly after using. A little olive or sweet oil on the needles will prevent rusting.

The sirup gauge and glass cylinder are essential to uniform success in making jelly. These may be obtained from any druggist at a cost of about 75 cents. A cylinder with

a lip as illustrated and holding a



(*a*) *Glass cylinder;* (*b*) *sirup gauge;* (*c*) *wooden vegetable masher.* (*Maria Parloa.*)

little over a gill is the best size. The sirup gauge is a glass tube with a weighted bulb so graduated as to register 0° to 50°. To use the sirup gauge, fill the glass cylinder to about two-thirds of its height with a sample of the liquid to be tested. Insert the gauge and the quantity of sugar present, if any, will be registered. In pure water the bulb will rest on the bottom. The more sirup is dissolved in the water the higher the gauge will rise. When testing hot liquids, the gauge and cylinder must be heated gradually to avoid breaking. The fruit juice or sirup either for canning, preserving or making jellies may thus be tested at any stage. The sirup may be made heavier by adding sugar or lighter by adding water as the case demands.

Alcohol Stove.—A proper stove is a very important consideration. Produce is ordinarily ready for canning in sultry weather, and the heat of a cook stove or range is so unbearable that the process rarely receives the quality of skill and the degree of attention that the best results demand. A tired and overheated housekeeper is in no mood to closely observe the delicate points that contribute to the perfection of a high grade product. Housekeepers fortunate enough to enjoy the use of gas will need no suggestion to use a gas range for canning fruit, and at a time when the oven burners are not lighted. But where there is no available supply of gas a two-burner stove consuming denatured alcohol is especially recommended. This is self-contained and portable. Thus the whole apparatus for canning fruit can be moved into a large, cool room, into an outhouse, or if desired in still, clear, or sultry weather, out of doors on the veranda, or in the shade of a tree on the lawn. At all events, an effort should be made to "keep cool" in both senses, if one is ambitious to obtain the best possible results.

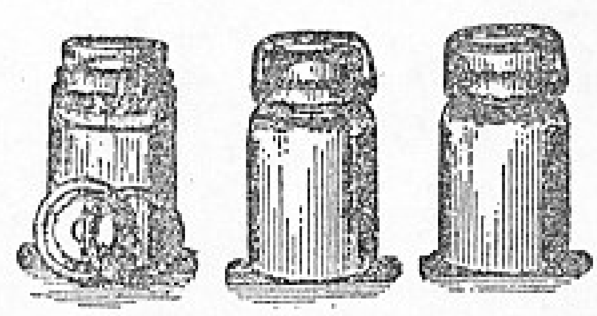
Materials for Canning and Preserving.—The materials used for canning and preserving should invariably be of the finest quality. Only the best grade of white granulated sugar should be used. And this should be clarified as described under candy making. Fresh, ripe fruit and vegetables of the best quality should be selected and carefully picked over. All bruised, specked, or wormeaten specimens should be discarded. Small fruits, as raspberries and strawberries, and all vegetables, should be canned if possible the morning they are picked. Great care should be taken in handling produce to avoid bruising it. A silver paring knife should be used for fruit as an iron or steel knife tends to darken it. The fruit when pared should be instantly dropped into a vessel of clear cold water, care being taken that it is not bruised in falling. This prevents the fruit from "rusting" or turning dark by exposure to the air. All hard portions should be removed as they resist the effects of heat. And all "specks" or decayed portions since they injure the flavor and color.

The best quality of canned fruit is obtained by heating fruit in the jars as hereafter described. This method avoids bruising the fruit by stirring, lifting, or pouring it from one vessel to another. Particular attention and care when preparing all canned goods will be amply repaid in the improved quality of the product. If fruit is pared, the work should be done thoroughly and no particles of skin allowed to remain. If the cores, pits, or stones are removed at all, the work should be done in a painstaking manner. Especially if the goods are offered for sale, a small fraction of additional labor at the start will add largely to the price and salability of the product. For similar reasons only the best quality of spices, brandy, or other condiments should be used.

PROCESS OF CANNING AND PRESERVING

Nature of the Process.—Canning or preserving is a process of killing, by means of heat, the germs that cause decay and preventing the contact of other germs by covering the produce with boiling sirup and sealing it hermetically so as to exclude the air. The reason that boiling is necessary, is that the germs of decay may be already present in the substance of the produce itself. Hence it must be boiled until the heat has penetrated every part and effectually destroyed the germs. And the reason that air must be excluded is that the microscopic germs that cause putrefaction float in the air in very large numbers. Hence if a bubble of air remains among the fruit, or if air is admitted through a crevice as fine as a needle point in the rubber ring or metal top of the jar, putrefaction will certainly result.

Other substances such as clear water or fruit juices exclude the air as well as sugar sirup. Sugar is added partly because it makes the product more palatable and nutritious, and partly because the presence of sugar is unfavorable to bacterial growth. Hence the amount of



(*a*) *Spring-top jar;* (*b*) *position of spring during sterilizing;* (*c*) *position of spring after sterilizing.*

sugar to be added to a given quantity of fruit may be varied at will. The old-time rule for "preserving" was pound for pound, but this is by no means necessarily an invariable principle. The present tendency is in favor of "canning." The pound-for-pound preserves are regarded by many as unnecessarily sweet and ex-

pensive. A much thinner sirup is commonly used in canning and, provided proper precautions are taken, preserves the fruit equally well. Or, if desired, fruits and fruit juices and in fact any kind of vegetable, may be canned without the addition of any sugar at all.

To sum up, the produce must be thoroughly boiled through and through. The jars must be filled to overflowing with boiling hot sirup or other liquid so that all bubbles of air will be excluded. Then they must be instantly sealed, else the contents will cool slightly and leave a space filled with bacteria-laden air between the top and the jar cover. The jar must be provided with a tight ring of new rubber or other substance that will absolutely exclude the air or the bacteria that it contains. Such substances as blotting paper and cotton batting are sometimes used for the reason that they have the property of screening or filtering the air so as to prevent bacteria from passing through.

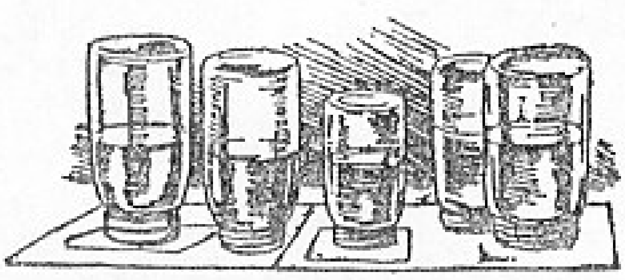
Methods of Canning and Preserving Fruit.—There are two different ways of canning or preserving fruit, either of which will give satisfactory results: (1) boiling the fruit in the jars or cans, or (2) boiling it in a preserving kettle. The old-time method of "preserving" consisted in boiling the fruit in a suitable preserving kettle, in sugar sirup, lifting it from the sirup when sufficiently boiled, packing it into jars or cans and pouring the boiling sirup over it. This method is still preferred by many.

The modern method of "canning" consists in packing the fruit in the cans or jars without sugar, or with sugar sprinkled between the different layers at the rate of about one tablespoonful to each pound of fruit, placing the jars on the stove in a suitable receptacle surrounded by water, bringing the whole to a boil and finally filling the cans with boiling sugar sirup and sealing them.

Canning is somewhat slower unless a large receptacle is provided in which to place a considerable number of fruit jars while boiling. But the process is easier and is likely to give a more satisfactory result. All bubbles of air are driven out of the fruit while boiling. And the jar itself is uniformly heated, so that when boiling sirup is added to fill it to the brim, it does not shrink by cooling in the moment of time required to clap on the cover and seal. Then, too, the fruit is undisturbed, and its shape, color, and texture are not injured.

Preserving Day.—Many housekeepers prefer, when putting up fruits for home use, to prepare a jar or two each day, selecting the finest fruits as they ripen. Thus the labor is distributed over the season and associated with other cooking from day to day so as to be hardly realized. But it is of some advantage, when a considerable quantity of fruit is to be preserved, to get everything in readiness at one time and make a day of it.

To Test Jars.—The contents of several jars may be saved in the course of a season by testing the



"Testing the Jars before Using."

jars before using. To this end, fill them with warm water, put on the new rubber rings that are to be used, seal them and stand them upside down on a large sheet of blotting paper. Or butcher's brown paper, or an ordinary folded newspaper, will answer. If there is the slightest leak, the water will trickle out and be seen on the absorbent paper. Thus defective rubber rings, or uneven, nicked, or cracked jar tops can be discarded and assurance can be had that no valuable material and labor will be wasted. Similarly, it is a good plan to turn the filled jars upside down on absorbent paper and let them stand overnight before storing them away. If by chance a defective ring or jar has been used it will be detected and the contents can be transferred to another jar.

To Sterilize Jars.—The first step is to place in the special boiler above mentioned, or in a preserving kettle, the jars that are to be used, with about one tablespoonful of borax to twelve quarts of cold water, and bring them to a boil over a slow fire. The tops and rubber rings should be put in place and boiled with the jars themselves. They are unfit for use if they will not stand this process. Jars having glass tops should invariably be given the preference. This will effectually kill all germs, free the jars from dust and dirt, and also toughen them so that, if properly handled, they will not crack in the process of canning. After they have boiled fifteen minutes or so, pour off the borax water and pour over them hot water to rinse them. Care must, of course, be taken not to pour cold water over hot jars, or expose them to a draught of cold air while hot, or they may be cracked and broken.

Canning Fruit.—After the jars have been thus rinsed and sterilized, replace them on the stove in the above-mentioned boiler or other suitable receptacle, surround them with hot water, and pack in the fruit, either without sugar, or with sugar sprinkled among the layers of fruit at the rate of one tablespoonful to a pound of fruit up to a teacupful to each can, more or less, as desired. Boil until the fruit is soft enough so that a straw can be run through it. The time required will vary according to the fruit, from a few minutes in the case of small fruits, as raspberries, strawberries, and others, to an hour or more in the case of hard pears, quinces, and the like. But observe that the latter cannot be cooked properly in the cans. They must be done up in the preserving kettle in the old-fashioned way. And there is the less objection as their firmer texture protects them from being injured by handling.

Berries and small fruits of soft and delicate texture, undoubtedly present a better appearance and have a finer flavor and color if cooked in the can. These include cherries, strawberries, raspberries, huckleberries or blueberries, ripe peaches, summer pears, and ripe plums.

Some fruits cooked in the can with sugar, shrink and leave the can only partly full. Do not attempt to crowd the cans when first filled as this will crush the fruit and injure its appearance. Remove one can and gently pour its contents into the tops of the others until all are full. Finally, when sufficiently boiled, remove the jars one by one, wrapping a towel about each; pour boiling sirup on top until it runs over and instantly seal before the contents cool,

and air is admitted. Place the jars in a warm place and out of a draught, as otherwise they may crack in the process of cooling.

Sirup for Canning and Preserving.—The strength of the sirup to be used in filling jars after the fruit has been cooked in them is a matter of individual preference. It also depends upon the amount of sugar, if any, that has been sprinkled in the fruit while cooking.

The old time pound-for-pound rule called for ½ a pint of water more or less, for each pound of sugar and pound of fruit, according to the amount of juice in the fruit. But a larger amount of water is more commonly used at present. To prepare sirup, place the sugar in a small preserving kettle, pour the required amount of cold water over it and stir until the sugar is fully dissolved before placing on the fire. The sirup will be clarified and improved by the addition of a little gum arabic or white of egg. The scum, as fast as it rises, may then be removed with a skimmer, taking all impurities with it. This sirup may be poured over the fruit after it has been cooked in the can.

Or according to the earlier method, the fruit may be dropped into the clarified sirup while at a boiling point, cooked until it is tender, removed with a skimmer, packed in the jars and the boiling sirup added until they are filled to overflowing.

PRESERVES AND PRESERVING

Preserving Fruit.—The process of preserving is a very simple one, although it takes a large amount of time and great care. However, any housekeeper can accomplish it. The principal secret of success is that the fruit should be put up and sealed while hot and the jars filled to the brim. It is usually the custom to place the fruit in the kettle, a layer of fruit and a layer of sugar, pound for pound or measure for measure and to let the whole come to a boil at once.

Or place the fruit in a vessel without the sugar. Put just enough water over it to keep it from scorching, and allow it to boil until the scum rises. Carefully skim away the scum while it continues to rise before adding the sugar. Many seem to think that the scum rises entirely from the sugar, but the experience of those who have used the above-mentioned method is that an equal amount of scum comes from the boiling fruit.

Or weigh the sugar and the fruit, pound for pound, then place the sugar in the kettle without the fruit. Put in just enough water to dissolve the sugar and stir until it is dissolved. Now place on the fire and let come to a boil. Continue to simmer for half an hour or so before dipping in the fruit, being careful to skim away the scum as it rises. Then place the fruit in the boiling liquid and let it continue to simmer on the back of the stove until the fruit becomes thoroughly impregnated with the sirup.

When about half done lift the fruit from the boiling sirup, place it in large porcelain or other vessels, being careful not to allow any sirup to come with it, and place it in the sun for an hour or more to bleach. After this, again drop the fruit into the sirup and let it boil until tender enough to allow a straw to run through it.

When the fruit is thoroughly done, if the sirup is not as thick as desired, it may continuously simmer until the desired thickness is reached. Then place the fruit in glass jars that have been previously heated and sterilized by boiling in water containing a little borax and rinsing in hot water. After filling the jar with fruit as full as you conveniently can, pour in the boiling sirup until it fills up all the crevices between the fruit, excluding all the air possible. While performing this process, place the jar in a pan filled with hot water. This will prevent cracking the jar.

CANNING SMALL FRUITS

The method of canning such small fruits as raspberries, blackberries, currants, gooseberries and blueberries, is substantially the same except for the proportions of berries, sugar and water required. Select fruit just before it is perfectly ripe—choose an underripe rather than overripe fruit—and can promptly while freshly picked. Discard all imperfect fruit. Gnarled, broken or otherwise defective specimens not decayed, may be used for marmalade or jellies. Avoid berries having a large proportion of seeds to pulp and if no other can be obtained—as may happen during a dry season—remove the seeds by rubbing through a sieve and preserve the strained pulp as marmalade or purée. Pick over the berries, hull and stem them and drop the perfect fruit in small quantities into a colander. Rinse in cold water and turn them on a sieve to drain. Do this quickly so that the fruit will not absorb too much water.

Have ready two bowls, one for sugar and one for fruit. Observe how much of each will be required to fill the preserving kettle or the number of jars desired. Measure the fruit into the proper bowl as fast as it is picked over and washed, and for each measure of fruit add to the other bowl the proportionate amount of sugar. When the required quantity of fruit and sugar has been measured, put both into the preserving kettle, add the required amount of water, if any, and while the first kettle is cooking prepare the fruit and sugar for another. Fruit designed to be served as sauce may have any proportion of sugar cooked with it according to taste, or if intended for beverages or cooking purposes, it may be canned without the addition of sugar. Juicy fruits require little or no water, except when cooked in a heavy sirup. The above are general rules which require to be modified for particular fruits as follows:

For raspberries and blackberries use 2 quarts of sugar to 12 quarts of fruit. First express the juice from 2 quarts of the fruit by heating it slowly on the stove in the preserving kettle, crushing with a wooden vegetable masher and squeezing through cheese cloth. Rinse the preserving kettle, pour into it the strained juice, add the sugar, heat and stir until the sugar is dissolved.

Let the sirup come to a boil, add the remaining 10 quarts of berries and heat slowly. Boil ten minutes from the time it begins to bubble and skim carefully while boiling. Can and seal as above directed.

For currants the process is the same as for raspberries and blackberries, but the proportions are different, namely: 4 quarts of sugar to 12 of fruit. For raspberries and currants combined use 2½ quarts of sugar to 3 quarts of currants and 10 quarts of raspberries. First express the juice from the currants as above directed, then proceed as for raspberries.

For green gooseberries use 1½ quarts of sugar and 1 pint of water to 6 quarts of fruit. Dissolve the sugar in the water, add the fruit and cook fifteen minutes. Or can the same as rhubarb. For ripe gooseberries use only one-half as much water.

For blueberries use 1 quart of sugar and 1 pint of water to 12 quarts of berries. Put all together in the preserving kettle and heat slowly. Boil fifteen minutes from the time the mixture begins to bubble.

For cherries use 1½ quarts of sugar and ½ pint of water to 6 quarts of fruit. Measure after stemming. Stone or not as preferred, but if the stones are removed, take care to save the juice. First stir the sugar into the water over the fire until dissolved, then add the cherries and bring slowly to a boil. Let boil ten minutes, skimming carefully.

For grapes use 1 quart of sugar and 1 gill of water to 6 quarts of fruit. First squeeze the pulp from the skins. Cook it five minutes and rub through a fine sieve to remove the seeds. Now bring the water, skins and pulp slowly to a boil. Skim, stir in the sugar and boil fifteen minutes. If the grapes are sweeter or more sour than ordinary, use more or less sugar, according to taste.

Rhubarb may be cooked and canned with sugar in the same manner as gooseberries, or either rhubarb or gooseberries may be canned without heat as follows: Cut the rhubarb when young and tender, wash thoroughly, pare and divide into pieces about two inches long. Pack in sterilized jars, fill to overflowing with cold water and let stand ten minutes. Drain off the water and once more fill to overflowing with fresh cold water. Seal with sterilized rings and covers. When the cans are opened the rhubarb may be used in all respects the same as if fresh.

CANNING LARGE FRUIT

Such large fruit as apples, pears, peaches and quinces must usually be pared and cored before canning. Select first class fruit just before it is ripe—preferably underripe rather than overripe—and discard all imperfect specimens. It is better not to can or preserve spotted or bruised fruit, but if such are used, all decayed or bruised spots must be freely cut out. Measure the fruit as soon as it is pared and cored into a large bowl containing cold water made slightly acid with lemon juice at the rate of one tablespoonful to the quart. This will keep the fruit from turning brown. For each measure add the proportionate quantity of sugar into another bowl until the amount of fruit and sugar needed to fill the preserving kettle or required number of jars is at hand.

To peel peaches, plums or tomatoes, have ready a deep kettle a little more than half full of boiling water. Fill a wire basket or colander with the fruit and suspend it by means of a string through the handles, or otherwise, in the boiling water for three minutes. Now remove and plunge the basket for a moment into a pan of cold water. Let drain a few moments and peel. The process of canning in general is much the same for all fruits, but the following special modifications for particular fruits may be observed:

For peaches and ripe pears use 1 quart of sugar and 3 quarts of water to 8 quarts of fruit. Prepare the fruit either whole or in halves as desired. If the latter, remove all the pits except a few in each jar which retain for the sake of their flavor. Stir the sugar into the water over the fire until dissolved and bring slowly to a boil. Skim carefully and let stand where it will remain hot but not boil. Put only a single layer of the prepared fruit in the preserving kettle at a time and cover with some of the hot sirup. Bring slowly to a boil, skim carefully, boil gently for ten minutes, or longer if not fully ripe, can and seal. The fruit is not done until it can be readily pierced with a straw or a silver fork. Unripe or hard pears will require much longer boiling.

For quinces use 1½ quarts of sugar and 2 quarts of water to 4 quarts of fruit. Rub the fruit hard with a coarse crash towel. Then wash and drain. Pare, quarter and core and drop the pieces into cold water acidulated with lemon juice. Cover the fruit in the preserving kettle with plenty of cold water, bring slowly to a boil and let simmer until tender. Remove the pieces one by one as soon as they can readily be pierced with a silver fork and let drain on a platter. Now strain the water in which the fruit was cooked through cheese cloth and put 2 quarts of the strained liquid over the fire. Stir in the sugar until dissolved, bring slowly to a boil, skim well, add the cooked fruit and boil gently for about twenty minutes.

For crab-apples use 1½ quarts of sugar and 2 quarts of water to 6 quarts of apples. A part of the stem may be left on the fruit if desired, but wash carefully and especially rub well the blossom end. Stir the sugar into the water over the fire until dissolved, bring slowly to a boil, skim, add the fruit and cook gently from twenty to fifty minutes, or until tender, depending upon the kind of fruit.

For plums use 2 quarts of sugar and 1 pint of water to 8 quarts of fruit. Wash and drain the fruit and remove the skins if desired as above suggested. Or if they are left on, prick them thoroughly with a fruit pricker to prevent bursting. Stir the sugar into the water over the fire until dissolved, bring to a boil and carefully skim. Add the fruit in small quantities one or two layers at a time, cook five minutes, can and seal and so continue, adding more sirup from time to time if necessary.

FRUIT PRESERVING

While the modern method of can-

ning fruits with small quantities of sugar or none at all is to be preferred in most cases, there are a few fruits which make preserves of such excellent quality that their use may be recommended for special occasions. These are strawberries, sour cherries, sour plums and quinces. They should be put up preferably in tumblers or small jars.

For strawberries use equal weights of sugar and fruit. Put a layer of berries in the bottom of the preserving kettle and sprinkle over it a layer of sugar. So continue until the fruit and sugar are about four inches deep. Bring slowly to a boil, skim carefully and boil ten minutes from the time it begins to bubble. Now pour upon platters to a depth of about two or three inches and place these in a sunny window in an unused room for three or four days, when the preserve will thicken to a jelly-like consistency. Put the cold preserve into jars or tumblers and seal. The large proportion of sugar present in this and other preserves is unfavorable to the growth of bacteria and thus prevents them from spoiling.

For white currants select large firm fruit, remove the stems and proceed as for strawberries.

For cherries select the sour varieties such as Early Richmonds and Montmorency. Remove stems and stones and proceed as for strawberries. Or cherries may be preserved with currant juice. Use for this purpose 2 quarts of sugar to 3 quarts of currants by heating in a preserving kettle, crushing them as they boil up and straining through cheese cloth. Stem and stone the cherries taking care to save all the juice. Add the cherries to the fruit juice, stir in the sugar over the fire, bring to a boil slowly and carefully skim. Boil twenty minutes. Put in sterilized jars or tumblers and seal. This gives an acid preserve. The quantity of sugar may be doubled if desired.

For plum preserve use 2 quarts of sugar to 1 pint of water and 4 quarts of greengage or other plums. If the skins are left on, prick the fruit and cover with plenty of cold water. Bring slowly to a boil and let boil gently for five minutes. Drain well. Now stir the sugar into the water over the fire until dissolved and boil five minutes, skimming well. Add the drained fruit and cook gently twenty minutes. Put in sterilized jars. Remove the skins from the white varieties.

For quince preserve use 2 quarts of sugar to 1 quart of water and 4 quarts of fruit. Pare, quarter and core the quinces. Boil in clear water until tender, skim and drain. Now stir the sugar into the water until dissolved, bring slowly to a boil, skim well and boil for twenty minutes. Pour one-half the sirup into another kettle. Put one-half the cooked and drained fruit into each kettle, simmer gently half an hour and put in sterilized jars. Preserve the water in which the fruit is boiled and add to it the parings, cores and gnarly fruit to make jelly.

Purées and Marmalades.—These preserves are merely crushed fruit pulp cooked with sugar. Purées differ from marmalades in being cooked with a small quantity of water and not cooked so long. They retain more of the natural fruit flavor. This process is especially useful for preserving small seedy fruits for frozen desserts, cake and puddings. Pick over and remove leaves, stems and decayed portions, or peach, plum and cherry pits. Rub through a purée sieve and add to each quart of strained fruit a pint of sugar. Pack in sterilized jars, put the covers on loosely and place on the rack in the boiler. Put enough cold water in the boiler to come half way up the sides of the jars. Bring slowly to a boil and boil thirty minutes from the time the water begins to bubble. Remove the jars from the boiler one by one, place in a pan of hot water, fill with hot sirup and seal.

For marmalade pick over berries with great care and rub through a fine sieve to remove the seeds. Remove all cherry, plum or peach pits. Wash, pare, core and quarter large fruit. Allow 1 pint of sugar to each quart of fruit. Rinse the preserving kettle with cold water leaving a slight coat of moisture on the sides and bottom. Put in a layer of fruit, sprinkle with a layer of sugar and so continue until all the fruit and sugar are used. Heat slowly and stir very frequently so as to break up the fruit as much as possible. Cook for about two hours and put in small sterilized jars.

Fruit Preserved in Grape Juice.—Any kind of fruit can be preserved by this method without the use of sugar, but it is particularly recommended for apples, pears and sweet plums. Boil 6 quarts of grape juice in an open preserving kettle down to 4 quarts. Have the fruit washed and pared and large fruit quartered and cored. Cover the prepared fruit with boiled grape juice, boil gently until tender and put in sterilized jars.

Boiled Cider.—Choose cider that is perfectly fresh and sweet. Fill an open preserving kettle not over two-thirds full and boil down one-half, skimming frequently. Put in bottles or stone jugs and use to improve mince meat or make cider apple sauce.

Cider Apple or Pear Sauce.—Use 5 quarts of boiled cider to 8 quarts of pared, quartered and cored fruit. Cover the prepared fruit with boiled cider and cook for two or three hours, or until clear and tender. Place the kettle on an iron tripod or ring to prevent burning. But if necessary to stir the sauce take care to break the fruit as little as possible.

JELLY MAKING

All fruit when ripe or nearly so contains a substance called pectin which has properties somewhat similar to starch. All housekeepers know that starch when boiled in water cools in a jelly-like mass. A similar property in pectin causes fruit juices, when properly boiled, to jell. But if fruits become overripe, or if fruit juices ferment or are cooked too long, the pectin undergoes a change and loses this power. Experience has shown that a definite amount of sugar dissolved in the fruit juice—namely, 25 degrees as registered by the sirup gauge—is exactly right for combining with pectin to make jelly. Any excess of sugar tends to form crystals and the presence of these tends to cause the whole mass to crystallize. Moreover, if the sirup boils so rapidly that some of it rises on the sides of the preserving kettle, such particles will form crystals and these, if stirred into the sirup, may crystallize the whole. Hence the three chief secrets of jelly making

are: (1) The selection of fruit which is just ripe, or slightly underripe; (2) the use of the sirup gauge; and (3) slow and careful boiling with especial care not to boil too long. The sirup gauge should register 25 degrees for every kind of fruit without exception.

Housewives are often perplexed because one lot of jelly crystallizes or refuses to harden, whereas another prepared by the same recipe and treated under apparently similar conditions is entirely satisfactory. The difference may be due to either of several causes. One lot of fruit may be overripe or may contain a greater or less proportion of fruit sugar than another. Or the difference may be caused by too rapid or prolonged boiling. Fruit picked during a cold, wet season or immediately after a rain will contain a good deal more water and consequently a less proportion of sugar than if picked after a prolonged period of heat and sunshine. Hence if the proportion of sugar is determined solely by measurement, somewhat less than a pint of sugar will be required for a pint of juice during wet seasons and vice versa. For the same reason small fruits should be washed quickly and thoroughly drained to prevent their absorbing much water. But the use of the sirup gauge will obviate all such difficulties. It measures the exact amount of sugar present, including both the natural fruit sugar and cane sugar added in the process of preserving.

Hence, in general, select for jelly making juicy fruit picked during a period of sunshine, or at least preferably not immediately after rain. Wash quickly, drain, express the juice, add to the clear juice about 1 pint more or less of granulated sugar to the pint of juice, boil, skim and pour into tumblers or small jars.

Acid fruits make the best jelly and the following are to be preferred in the order given: Currant, crab-apple, apple, quince, grape, blackberry, raspberry, peach. Wild raspberries, blackberries, barberries, grapes and beech-plums all make delicious jellies. Take care to choose barberries that are fresh and not overripe. Sweet fruits, such as apples, make a very mild jelly, but may be flavored with fruits, flowers or spices, but with the sour varieties this will not be necessary. Some fruits, such as the strawberry, contain very little pectin and are difficult to jell without the addition of some other fruit juice, such as the currant, when a pleasant jelly will result.

Currant Jelly. — To make good jelly from currants, raspberries, blackberries, ripe grapes and plums, proceed as follows: Pick over the fruit and remove all leaves, large stems and the like. Wash quickly, drain, and put fruit over the fire in a preserving kettle. Crush with a wooden vegetable masher or spoon enough to start the juice, heat slowly and stir frequently. When hot crush thoroughly with the vegetable masher. Express the juice into a large bowl through two thicknesses of cheese cloth spread over a hair or wire sieve. Let the juice drip without pressure, merely moving the pulp about by lifting the corners of the cheese cloth and slightly shaking the contents until all the free juice has been obtained. Use this to make the best quality of jelly either as it is or after first passing it through a flannel or woolen cloth or jelly bag. This will make a somewhat more transparent jell. Now remove the sieve to another bowl, twist the corners of the cheese cloth and squeeze out as much more juice as can be obtained. Use this to make jelly of a lower grade.

Measure the juice into a clean preserving kettle and stir in a pint of granulated sugar for every pint of juice until the sugar is dissolved. Place over the fire and bring to a boil slowly. Observe carefully the moment it begins to boil, withdraw from the fire and skim. Again bring to a boil, remove and skim a second and third time. Then pour into hot sterilized glasses and place these on a hot sunny window-sill covered preferably with panes of glass. When cool and firm seal and store in a dark, cool place.

Or jelly may be prepared directly from the strained juice without boiling by dissolving the required amount of sugar in the cold juice, pouring it into warm sterilized glasses and otherwise treating as before. Such jelly is more delicate but does not keep quite so well.

Other good jellies may be made by the same process from a mixture of equal parts of currants and raspberries, or a mixture of 10 quarts of strawberries with 2 quarts of currants, but the last méntioned must be boiled fifteen minutes.

For ripe grape jelly choose an acid grape, as the sweet varieties contain too much sugar, or use half ripe fruit or equal portions of nearly ripe and green grapes. Wild grapes are excellent.

For plum jelly use an underripe acid plum. Wash, stem and cook gently in 1 quart of water for each peck of fruit. Strain the juice and proceed as for currant jelly.

Apple and Crab-apple Jelly.—Large fruits such as apples, peaches and pears must be boiled in water to extract the pectin and flavoring matter they contain. As a rule 4 quarts of water added to 8 quarts of fruit will produce 3 quarts of strained juice, but juicy peaches and plums may require only 3 or 3½ quarts of water. Boil down the juice if necessary to 3 quarts. Stem and wash the fruit. Wipe dry and clean carefully the blossom end, and cut in quarters. Add 4 quarts of water to 8 of fruit and cook gently until soft and clear. Strain the juice, boil down to 3 quarts if necessary and proceed as for currant jelly. The quality of the jelly will depend upon the natural flavor of the fruit. Hence choose preferably a fine flavored acid apple and make the jelly at any time of the year when the fruit chosen is at its prime. Apple jelly made in the spring may be improved by the addition of the juice of a lemon to every pint of apple juice.

To make cider apple jelly, use cider fresh from the press instead of water.

Quince Jelly.—Rub the quinces with a coarse crash towel. Cut out the blossom end, rinse and drain. Wash and pare the fruit, quarter and cut out the cores, and keep them by themselves. Drop the best pieces of fruit into a bowl half full of water containing lemon juice, to be preserved or canned. Run the parings and imperfect parts through a meat chopper or chop finely. Add a quart of water to every 2 quarts of chopped fruits and parings and cook gently for two hours. Strain and proceed as for apple jelly. Put the cores into another kettle, cover with plen-

ty of water and cook two hours.

Now, to make a second grade of jelly, add the chopped parings and fruit from which the juice has been extracted, mix and strain. Return the clear juice to the preserving kettle, stir in a pint of sugar for each pint of juice and boil ten minutes.

Covering Jelly.—Cut out some discs of any thick white paper, preferably paraffin or butter paper, the size of the top of the jelly glass. A simple way to make a pattern of the exact size is by means of a small compass or pair of dividers. When the jelly is hard and firm, brush over the top with brandy or alcohol to kill any spores of mold that may be present. Dip a disc of paper in the spirits and let it rest on the jelly. Now put on the covers.

Or tie a disc of cotton batting over the top of the glass.

Or cut discs of paper about half an inch in diameter larger than the top of the glass, wet them in a mixture of the white of an egg beaten together with a tablespoonful of cold water and press down the sides until they stick.

Or cut covers about an inch in diameter larger than the top of the glass, dip in olive oil and tie on the glass with string.

Or pour melted paraffin in the top of the glass over a piece of paper dipped in brandy or alcohol. Set the paraffin in a cup surrounded by warm water and heat gently until melted. Make a layer at least one-fourth of an inch thick.

Fruit Juices. — These may be canned or bottled with or without sugar as desired. Use preferably self-sealing bottles such as pop or beer bottles with care to sterilize both bottles and corks.

For grape juice wash the grapes, pick them over and remove the stems and all defective specimens. To express the juice crush slightly in the preserving kettle, heat slowly and boil gently for half an hour. Crush the fruit and express the juice as for jelly making, except that all the juice may be preserved together. Bring the strained juice to a boil in a clean preserving kettle, remove and skim. Do this a second time. Then stir in the sugar until dissolved, boil five minutes, skim and put into hot sterilized bottles or jars. Set these in pans of boiling water in a moderate oven for ten minutes. Now fill up with boiling juice, seal and place on boards to cool protected from drafts. For grapes use about 1 gill of sugar to a quart of juice.

For raspberries, blackberries and strawberries, use ½ pint of sugar to each quart of juice and for currants a full pint, otherwise proceed as for grape juice.

For cherry, plum and peach juices add ½ pint of sugar to each quart of juice.

Fruit Sirups.—Proceed in all respects as for fruit juices, but use at least one-half as much sugar as fruit juice. Use fruit sirups to flavor ice creams and water ices, also for beverages at the rate of two or three spoonfuls to the glass of ice water.

Preserving Powders.—Avoid all so-called "preserving powders" whether advertised under various trade names or put up and sold by druggists or peddlers. Any antiseptics that will prevent the decay of fruits and vegetables are injurious to health regardless of all claims by interested persons to the contrary. Nothing of the sort is necessary if sound ripe fruit is selected and sterilized by means of heat in the proper manner. And since the necessary care to do good work adds little or nothing to the cost of preserving fruits and vegetables, the so-called "preserving powders" serve no useful purpose. On the contrary they tend to encourage unclean and slovenly work and to conceal the effects of using decaying fruits and vegetables.

CANNING VEGETABLES

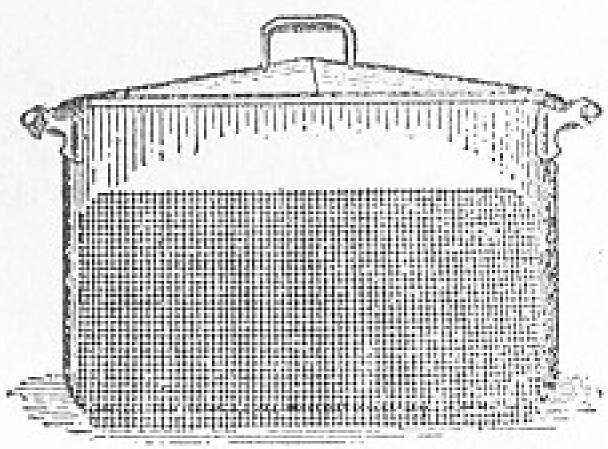
Some vegetables are more difficult to preserve properly than fruits and fruit juices, since they contain a considerable proportion of the element nitrogen, the presence of which makes any substance a good culture medium for the bacteria, spores and molds which cause decomposition. Moreover, the addition of sugar to fruits and fruit juices helps to produce a condition which is unfavorable to the growth of these injurious organisms. But the addition of sugar to most vegetables would not be desirable. Hence, a considerably longer and more heroic treatment for canning vegetables is required. The process, however, is simple and is so similar to the ordinary methods of canning fruit that it can be readily carried out by any housekeeper if the following suggestions are observed:

The secret of canning vegetables lies in the fact that whereas bacteria may be readily killed at the temperature of boiling water, the spores or seeds of certain kinds may retain their vitality unless they are kept at the temperature of boiling water for a long time—about five hours—or preferably boiled for about one hour upon two or three successive days. The latter is the method employed by scientific men and is the one here recommended. The first day's boiling kills all the molds and most of the bacteria but does not kill their spores or seeds. These start to grow as soon as the contents of the jar is cool. The second boiling kills the crop of bacteria thus formed before they have time to develop spores. The third boiling is not always necessary, but is advised to make assurance doubly sure. This process is called by scientists "fractional sterilization." It is the whole secret of canning meat, fruits or vegetables and anyone who will bear it in mind may be sure of satisfactory results.

Observe, however, that the air must be excluded at all times after the first boiling. Otherwise a new crop of bacteria, spores and molds will be deposited from the air and the work of sterilization will be undone. Cooking for three short periods in a closed container at a comparatively low temperature instead of cooking for one short period at a high temperature, or for one long period in an open vessel makes the vital difference and insures a freshness of flavor and color such that the difference between the product and the fresh vegetables can hardly be detected. After the jars have been sterilized and tested keep them in the dark, or wrap them closely in dark colored paper, as sunlight will soon destroy the color.

Canning Corn. — All housewives will be glad to know that corn is one of the easiest vegetables to can if proper precautions are observed. Select preferably the sweetest and most delicate varieties. Experiment has proved that the amount of sugar in sweet corn diminishes very rapidly after the ear is pulled from the

stalk. Hence endeavor to get the kernels into the can within an hour after the corn is picked. If this can be done the result will be far superior to the ordinary commercial product. Select ears with full grains, just before they begin to harden, since the corn is then sweetest. Husk the ears and remove the silks with a stiff brush. Sheer off the grain with a sharp knife, pack the jar full and salt to taste, usually at the rate of one teaspoonful to the quart. Fill up the jar to the top with clear cold water, put on the rubber ring and place the glass top on loosely but without depressing the spring. Now place the jars upon a false bottom in a wash boiler and separate them by means of rags or cotton rope, such as an old clothesline, so that they cannot strike one another when the water begins to boil. Pour



Sterilizer, showing false bottom. (J. F. Breazeale.)

in about three inches of cold water or enough to fill the boiler with steam. More than enough to prevent the boiler from going dry is not necessary as the steam will do the cooking. Cover the boiler tightly, bring to a boil and let boil for a full hour. Now remove the cover and allow the steam to escape. Press down the spring to prevent air from entering. Remove the jars to cool, or let them stand in the boiler until the next day.

On the second day raise the spring as before and again boil for one hour. Once more clamp down the top and let stand until the following day. Then repeat the operation. Observe that the jars when hot must be carefully shielded from drafts of cold air or the sudden change of temperature will crack them.

After the third boiling clamp on the top and let stand two or three days. Then test each jar by releasing the spring and picking up the jar by the glass top. If the top does not come off the contents are reasonably sure to keep unless there should chance to be one or more anaerobic bacteria present which may cause trouble later on. Should this happen increase the length of boiling for the next lot to 1½ hours.

If the tops come off when the can is tested, decomposition has begun to take place and gases have been formed which offset the atmospheric pressure on the outside of the jar. In this case it is best to reject the contents and to cleanse and refill the jar.

The above directions apply only to pint and quart jars. Increase the time of boiling for half gallon jars to one and a half hours. A little practice may be required at first to secure perfect results by this method; hence do not try too many jars the first time. Make a few experiments in the early part of the season until you fully understand the directions and learn to follow them properly. After that there will be no difficulty and the benefits of fresh vegetables from the kitchen garden will be extended to every season of the year.

The same general process applies to canning other vegetables except for the mode of preparing them, as to which the following suggestions are offered:

Stringbeans. — Pick these when young and tender, string, break into short lengths, pack firmly in the jar, cover with cold water and add a teaspoonful of salt to each quart. Otherwise proceed as for corn. Add a small bit of red pepper in the bottom of each jar, if desired.

Eggplant. — Pare, cut in thin slices and drop into boiling water for fifteen or twenty minutes. Drain and pack in jars. Proceed as for corn. Remove in slices when required and fry in bread crumbs, or make into puddings and bake.

Beets.—Pull while young and tender. Cut off the tops, wash and drop in boiling water for one and a half hours, or until thoroughly cooked. Skin, slice and pack in jars. Proceed as for corn. To pickle, cover with equal parts of water and good vinegar and sweeten to taste.

Okra or Gumbo.—Pick the pods while young and tender, wash, cut in short lengths and sterilize as above. Use for soups and stews.

Summer Squash.—Cut into small blocks, pack, cover with water, add salt and sterilize as above. Or skin, boil or steam until well cooked, mash, pack and sterilize. But in this case steam for an hour and a half each day as the heat penetrates the jar more slowly. Each jar will contain about twice as much of the cooked vegetable as if uncooked.

English Peas. — Choose young sweet peas and proceed as for corn. This product has all the delicate flavor of the fresh vegetable.

Asparagus.—Can the tips only, the same as for corn.

Cauliflower.—Prepare in summer the same as for serving at table. Pack in jars and sterilize.

Carrots and Parsnips.—Gather in early summer when the young plants are tender and sweet. Prepare as for serving at table and sterilize as for corn.

Turnips and Kohl-Rabi.—Prepare as for the table, pack and sterilize.

Lima Beans. — Pick before the pods begin to harden and treat as for corn.

Pumpkin or Winter Squash.—Preserve these in their natural condition in a suitable storeroom as long as possible. But should they show signs of decay, steam and can the same as summer squash. By this time the jars which have been emptied of other vegetables will be available and may thus be made to do double service.

Succotash. — Gather fresh corn and beans early in the morning. Prepare and sterilize as above. This is one of the most difficult things to can, hence boil an hour and a half each day as for summer squash.

Vegetable Roast. — Prepare corn, lima beans, tomatoes, stringbeans, okra, squash and eggplant as for canning separately. Mix in any desired proportions but let the corn and lima beans predominate. Add two or three medium sized onions to each quart and run through a food chopper to mix thoroughly. Pack into jars and sterilize by boiling an hour and a half each day for three days as for summer squash. To prepare for the table mix an equal

amount of bread crumbs, add a piece of butter the size of a walnut and one egg. Season to taste with pepper and salt and bake in a round baking dish until brown. Cut into slices like a meat loaf and serve hot with drawn-butter sauce.

Or corn, okra and tomatoes mixed in equal proportions may be canned as soup stock.

Stewed Tomatoes.—These keep very easily even in the common screw-top jar. Hence such jars may be set aside for tomatoes and the more modern styles used for canning other vegetables. In this case observe that the tops and rubbers must first be sterilized by placing them in cold water. Bring to a boil and boil for ten minutes. Handle as little as possible, especially the inside of the top or inner edge of the rubber. Fill the jar with the cooked tomatoes while steaming hot, put on the rubber, screw the top down firmly, invert it and let it stand in that position until cold. To prepare the tomatoes, wash and plunge them in boiling water for five minutes. Now dip for a moment in cold water, pare, slice and place them in a preserving kettle over an iron ring or tripod. Heat slowly and stir frequently from the bottom. Bring to a boil and then boil thirty minutes. Put in sterilized jars and seal.

Whole Tomatoes.—Use 8 quarts of medium sized whole tomatoes and 4 quarts of sliced tomatoes. Prepare the sliced tomatoes as for stewed tomatoes. Boil twenty minutes, rub through a strainer and return to the fire. Now pare the whole tomatoes and put them in sterilized jars. Pour over them the stewed and strained tomatoes until the jar is full. Put the uncovered jars in a moderate oven on a pad of asbestos, or in a shallow pan of hot water and cook for half an hour. Remove, fill to overflowing with boiling hot strained tomatoes and seal. Any strained tomatoes left over may be canned for sauces.

How to Open a Jar.—Run a thin knife blade under the rubber next to the jar and press against the jar firmly. If this does not let in enough air to release the pressure on the top, place the jar in a deep saucepan of water, bring to a boil and keep boiling a few minutes. It will then open easily.

Preservation of Meat and Vegetables

FERMENTATION—FRESH MEAT AND FISH—SALTING AND PICKLING MEAT—CURING HAMS, TONGUES, AND BACON—MAKING AND KEEPING SAUSAGE—PRESERVATION OF COOKED MEAT—TRYING OUT AND STORING LARD—PRESERVING, TESTING, AND PACKING EGGS—STORING AND PRESERVING VEGETABLES, FRUIT, NUTS, AND HERBS

FERMENTATION

Fermentation in the widest sense of the term includes all forms of decomposition in both vegetable and animal substances when exposed to air and moisture at temperatures between the freezing and boiling point of water. But in common language, the word fermentation is more often confined to those processes by which vegetable juices are transformed into alcoholic liquors. These processes, however, are entirely similar to putrefaction, or the decomposition of organic matter which sets free foul-smelling gases; and decay, or the change by which without moisture, the trunk of a tree molders into dust. Fermentation does not ordinarily take place much below 32° F. or much above 140° F. It usually causes liquids to rise in temperature and to give off gases with considerable internal motion, to become turbid, to form a scum and to deposit a sediment.

Among the useful results of fermentation are the raising of bread with yeast; the preparation of alcoholic beverages and certain food products, as sauerkraut; the curdling of milk by means of rennet to form cheese; the manufacture of vinegar, etc.

Among the injurious results of fermentation are the souring of milk and vegetables, the putrefaction of meat, the becoming rancid of fats and the decay of articles of wood or textile fabrics.

Fermentation is caused by the vital action of microscopic plants, the germs of which may be present in the fermenting substance, or may be deposited on their surface from the air or from contact with water or other substances containing them. Or they may be introduced intentionally, as when yeast is used for brewing, or for making vinegar or bread. These small plants feed upon fermentable substances and bring about various chemical changes. Thus the subject of fermentation has two phases: i.e., (1) how to induce those forms of fermentation that are useful, and (2) how to prevent those that are injurious.

The promotion of fermentation falls under such various subjects as fermented beverages, the making of vinegar, cheese, bread, etc. The prevention of fermentation falls under such subjects as the preservation of food, the preservation of timber, etc.

As fermentation occurs from the presence and development of germs, it is evident that its prevention depends upon the destruction of any germs that are present, and keeping away others, or the removal of conditions favorable to germ life. Hence, in general, fermentation and putrefaction may be prevented by drying heat; by cooling below the point at which fermentation takes place; by heating or cooking substances to a point sufficient to kill the germs present, and then hermetically sealing them to exclude others; and by the employment of various antiseptics, as alcohol, common salt, saltpeter, sugar, sirup, smoke, borax, and many other substances.

Putrefaction. — This change is a

decomposition of animal or vegetable substances with the liberation of ill-smelling gases. It can only take place at a temperature between the freezing point of water (32° F. and 140° F.), in the presence of moisture and after exposure to the air. Generally speaking, the more moisture and the greater warmth present, the more rapid is the process. The germs of the bacteria which cause putrefaction are heavier than the germs of yeast and mold, and hence do not float in equal numbers, as dust in dry air. They are more often communicated by contact with water or moist surfaces. For this reason in dry climates meats and vegetables may be preserved simply by drying or curing them by exposure to sunlight. But it is well known that if these substances are left out after the dew falls, and allowed to become moistened, they may be covered with a coating of mold. Most of the bacteria that cause putrefaction are killed by exposure to a temperature of 140° F. for a number of hours; to a temperature of 212° F., the boiling point of water, for ten to fifteen minutes; or to a temperature of 215° F. for 4 or 5 minutes. The activity of these bacteria ceases at the freezing point, but they cannot be killed by freezing, and again become active when warmed to a temperature of 40° F. Hence, in general terms, boiling in water kills bacteria and freezing suspends their activity.

FRESH MEAT AND FISH

To Keep Fresh Meat.—Refrigeration in a dry, well-ventilated air chamber cooled to a temperature of 40° F. or lower by means of ice, is the best means of preserving fresh meat in summer or in warm climates. For this purpose ice may be stored in northern climates in homemade ice houses, and utilized by means of homemade refrigerators as elsewhere recommended.

If ice houses are not available, fresh meat may be kept for several days by the use of sour milk, vinegar, charcoal, or borax, or by immersing it in cold running water, or by means of a mixture of salt, sugar, and saltpeter.

Or hang up joints of meat, if not required for immediate use in any dry, shady place where there is good ventilation. They will keep fresh from 2 to 4 days, and will become more tender and digestible by hanging. But in all cases, hang them with the cut end up and knuckle downward, or the reverse of the usual way. Thus the blood remains in the meat and keeps it sweet and juicy. In summer, if the weather is dry, lamb and veal will keep 2 days, and beef and mutton 3 to 4 days. In cold weather, mutton may be kept for twice that length of time.

Or if running water is available from a spring or otherwise, provide a covered box or tub in a shady place, into and out of which the water can flow. Immerse the meat in this. If fresh it will sink of its own weight. Look at it two or three times a day and as soon as it commences to rise from the bottom, it must be used. The outside will be somewhat whitened, but the flavor will be uninjured. The meat will be sound and tender after 3 or 4 days in hot summer weather, and may then be boiled or roasted.

Or pieces of fresh meat may be placed in large stone jars and covered with skimmed milk, sour milk, or buttermilk. They must be weighted with a clean stone to keep the meat under the surface of the liquid, and the jar placed in a cold cellar or in the running water from a spring. It is not necessary to remove the bone or fat. Thus fresh meat can be preserved for a week or 10 days. The milk can afterwards be fed to pigs. Before cooking, the meat should be washed thoroughly in clear water and afterwards soaked 3 to 5 minutes in water containing about one tablespoonful of cooking soda to the gallon. This neutralizes the acid of the milk and makes the meat more tender.

Or fresh meat may be preserved by soaking it for 3 to 5 minutes in a solution of one tablespoonful of borax to a gallon of water, or by rubbing it with powdered borax dry. Rinse with clear water when required for use.

Or trim the meat carefully with a knife, removing any parts that seem likely to taint, and wrap it up with a cloth moistened with vinegar, or equal parts of vinegar and water. The acid vapor drives away flies and the moisture, by evaporation, keeps it cold.

Or rub meat thoroughly with fresh powdered charcoal, which has powerful antiseptic properties. It can be readily rinsed off with clear water.

Or cut the meat in pieces, not exceeding 2 or 3 pounds in weight, and pack them down between layers of dry corn meal or bran. Or cover with corn meal or bran as thickly as possible and hang in some shady place where there is a free circulation of air.

Or when meat can no longer be preserved by any of these methods and more is on hand than can be immediately consumed, cook it all, and each day place it on the stove and bring it to a temperature equal to the boiling point of water. Thus the germs of putrefaction will be killed and the process will be arrested from day to day.

Or fresh meat may be preserved in the following manner: by laying it down in an earthenware jar and sprinkling with a mixture of salt, sugar, and saltpeter. If the meat is fresh killed, first hang it up or lay it on slats overnight to drain it free from blood. Then cut it up in readiness for the frying pan or the table, separating and trimming chops, steaks, scollops, etc. For every pound of meat, measure 1½ teaspoonfuls each of salt and sugar, ½ teaspoonful of saltpeter, and ¼ teaspoonful of black or white pepper. These should be dry, mixed, and reduced to powder in a mortar. Now sprinkle the bottom of the jar with a thin layer of this mixture and lay down a layer of steak or chops of uniform thickness, packing tightly to cover the bottom of the jar. Sprinkle over this the mixture of antiseptics so as to cover the surface lightly or about the same as when seasoning for the table. Add another layer of meat, and so on, until the jar is full. Cover the top of the jar with a layer of cotton batting wet in a solution of the same mixture of antiseptics in water. Put on the lid of the jar tightly and set it in a cellar, spring house, or other cold place. When the meat is required for use, rinse and scald it. Soak the cotton batting in the covering solution of antiseptics and pack it down closely over the meat as before.

Or the top of the jar may be covered with a layer of melted tallow, lard, or paraffin to keep out the air.

To Preserve Meat from Flies.—In addition to the germs that cause putrefaction, fresh meat is liable to be visited by flies and other insects for the purpose of depositing their eggs, and these will, in warm weather, quickly hatch and produce maggots. A cloth moistened with vinegar prevents the approach of insects.

Or the meat may be rubbed with ground pepper or ginger. It may also be protected by a coating of waxed paper. To prepare this paper, melt with gentle heat 5 ounces of stearic acid. Stir in 2 ounces of carbolic acid and add, in a thin stream, 5 ounces of melted paraffin, stirring constantly. Remove from the fire and continue to stir until the mixture sets. Again melt with gentle heat, and apply with a brush to suitable paper. Wrap up the meat in the paper and seal.

To Preserve Fish. — To keep fish fresh without ice for any length of time is very difficult. But if ice is not available, wash inside and out with a solution of equal parts of vinegar and water. Lay the fish on an earthenware platter on a stone floor. Place in the inside of each fish a cheese-cloth bag containing fresh charcoal in small lumps, about the size of small peas or large gravel stones, and wrap in a cloth moistened with vinegar, or equal parts of vinegar and water. In very hot weather remove the cloth and bag of charcoal two or three times a day and dip the fish into cold salt water. Afterwards wrap up as before.

Or if the fish shows signs of decay, immerse in a pickle of vinegar and water.

To Sweeten Tainted Meat.—Apply a solution of chloride of soda by means of a soft clean brush or sponge. With this quickly wash over the tainted portions and rinse immediately with fresh water. Afterwards broil or roast, the meat so as to expose the tainted portions to a high temperature and char them with the heat.

Or if they are to be boiled, place half a dozen lumps of charcoal, the size of an egg, in the water.

Or place a quantity of pulverized charcoal in a cheese-cloth bag, and place these in the kettle. All odors will be absorbed by the charcoal and the meat will be sweet and clean.

Or hang the meat on a nail in a box, or suspended inside of an inverted barrel. Place beneath half a teacupful of table salt in an earthenware bowl and add by degrees 2 ounces of sulphuric acid at the rate of ½ ounce each 15 or 20 minutes, until all has been added. The resulting fumes will disinfect anything with which they come in contact. But care must be taken not to breathe them. Afterwards rinse the meat well with a solution of 1 tablespoonful of baking soda or borax to a gallon of water.

To Keep Frozen Meat. — In cold climates and in winter, meat may be preserved indefinitely by allowing it to freeze. But it must not be permitted to freeze and thaw frequently, and must not be thawed out too quickly when required for use. To preserve meat by freezing, first expose it to the weather until thoroughly frozen through and through. Wrap in waxed paper or cover with a cloth coated with shellac or other varnish and pack in an ordinary flour barrel between layers of hay, straw, or excelsior, pressing the whole as tightly and solidly as possible. Place the barrel in a bin or packing case, and surround it with a layer of 5 or 6 inches of dry sawdust.

To thaw frozen meat when required for use, place it in a moderately warm room at a distance from the fire, and allow it to thaw gradually.

Or better still, soak it 2 or 3 hours in cold water.

If thawed too quickly it will be unfit for use.

SALTING AND PICKLING MEAT

Curing Meat.—Among the various methods of preserving beef, pork, mutton, and other meats for considerable periods of time, are drying, canning, pickling, and smoking. Drying meat is practiced chiefly in hot climates and in localities where the air is free from moisture. It is accomplished by cutting the meat into convenient pieces and exposing it to direct sunlight on suitable drying forms so arranged as to admit of a free circulation of air. The canning of meat is similar in principle to the process of canning fruit and vegetables. It consists in cooking the meat until tender, placing it while at the boiling point in sterilized jars, and sealing while hot so as to exclude the air. In addition, it is customary to pour over the meat the gravy or meat jelly in which it has been cooked, in the same manner that sirup is poured over canned fruits. Pickling consists in immersing the meat in a solution of antiseptics, usually salt, sugar, and saltpeter with soda or potash. Smoking is accomplished by suspending the meat in a suitable chamber, exposed to the fumes of smoldering corncobs, hickory or beech chips, sawdust, or other substances. The antiseptic effect of smoking is due to impregnation with pyroligneous acid, an impure acetic acid which, together with tarry matter is contained in the smoke. The effect of smoking is therefore similar to that of rubbing fresh meat with vinegar, except that the admixture of tarry matter prevents the acetic acid from escaping by evaporation.

Pickling Meat.—The points to be observed in pickling are cleanliness and sterilization. That is, all foreign matter, as blood, dirt, and the like, should be removed from the meat, and the tubs or casks in which it is packed should be sterilized. In addition, of course, the pickle must be sufficiently strong, and the meat fully covered with it and heavily weighted. If these precautions are observed, there is no reason why meat cannot be kept sweet the year round.

Preparation of Meat for Pickling.—The beef, pork, or mutton carcass to be pickled should be carefully cut into strips of equal thickness, so that it can be packed tightly in tubs or casks in uniform layers. The carcass should be cut up as soon as the animal heat is out of it, and the pieces

"Pour Over it the Pickling Liquid."

to be pickled rubbed thoroughly with fine salt or powdered saltpeter or a mixture of these dried in a slow oven. After the salt and saltpeter have been well rubbed over the surface of the meat, sprinkle the pieces lightly with the same, and lay them on slats or boards slanted so that the blood will drain off, and let them stand from 24 to 48 hours. This will remove all the surface blood and leave the meat fresh and clean. When the necessary tubs or casks and pickling liquid are in readiness, rinse off the meat by dashing cold water over it from a dipper or pail. Wipe dry with a clean cloth. It will then be perfectly clean and ready to pack.

Pickling Liquid for Meat.—A full barrel, if properly packed, will contain about 280 pounds of meat and will require from 6 to 8 gallons of pickle. The proportions of salt, saltpeter, and sugar recommended are about as numerous as the various authorities. But as these antiseptics do their work separately, the proportion is not essential, provided the pickle is strong enough. To prepare a standard pickling liquid, place in a large kettle 8 gallons of pure soft cold water, to which add 14 to 16 pounds of pure salt, 4 to 6 ounces of saltpeter, about 6 pounds of good brown sugar, or about 3 pounds of the sugar and an equal bulk of good New Orleans molasses. To which may be added 2 to 6 ounces of pure baking soda. Place the whole over a slow fire and bring to a boil with very gentle heat, removing the scum as it rises so as to have the liquid clear before it boils. After the pickle has been clarified, remove from the fire. Cover to keep out the dust and let stand until it becomes cold.

To Pack Meat.—Scald thoroughly the inside of the tubs or barrels by pouring into them boiling water and washing down the sides with a swab of clean cloth tied to the end of a stick or clean mop handle. Cover the bottom of the cask with common salt ½ inch or more in depth. Pack the meat in layers as tightly as possible with common salt sprinkled between them and, when packed, pour over it the cold pickling liquid through cheese cloth until the barrel is full. Place on top a loose cover of wood, previously scalded, small enough to slip inside of the barrel and rest on the meat. Lay on this a stone or other heavy weight, to keep it below the surface of the pickle, and be sure that the pickle does not evaporate so as to leave the meat exposed to the air. Otherwise it will rust. The above is a general method to which the following favorite recipes may be added to show the manner in which the proportions may be changed according to the experience of different individuals. But all of these are tested recipes.

Pickle for Beef.—Dissolve in 8 gallons of soft water 20 pounds of coarse fine salt, 8 ounces of saltpeter, and 4 pounds of coarse brown sugar. Bring to a boil with very gentle heat, skimming constantly. This quantity is sufficient for one full barrel, or 200 pounds of beef, if properly packed.

Or prepare in a similar manner a pickle containing 14 pounds of coarse fine salt, 2 ounces of saltpeter, 2 ounces of Cayenne pepper, 3 pints of New Orleans molasses, 2 pounds of brown sugar, and 12 gallons of soft water.

Or 10 pounds of salt, 1 ounce of saltpeter, 2 pounds of brown sugar, and 6 gallons of soft water.

Or 12 pounds of salt, 4 pounds of brown sugar, 4 ounces of saltpeter, 8 gallons of soft water, and 4 ounces of potash.

Or 2 quarts of coarse fine salt 3½ quarts of molasses, 2 teaspoonfuls of saltpeter, and 8 gallons of soft water.

Pickle for Beef.—Any of the above pickles may be used.

Or for a full barrel of beef, or 200 pounds, dissolve in 8 gallons of pure soft water 10 ounces of coarse fine salt, 4 ounces of saltpeter, 3 pints of New Orleans molasses, and 2 pounds of brown sugar. Place over a slow fire and bring to a boil, skimming constantly.

Or 15 pounds of salt, 2 pounds of sugar, 6 ounces of saltpeter, and 2 ounces of baking soda in 8 gallons of soft water.

Salting Meat.—Another method of curing meat is to rub or pack it with a mixture of salt, sugar, and saltpeter, but without water, thus allowing the meat to form a brine by means of its own juices. If the brine which forms is allowed to drain from the meat, it is said to be dry-salted. Or if the meat is packed in a tight receptacle, and the brine is allowed to remain over it, it is said to be wet-salted.

To salt beef or pork, first remove all bones. Rub the pieces, especially the cut surfaces, with a mixture of 1 pound of salt, 1 ounce of saltpeter, and 1 ounce of sugar. Use pressure enough to rub the salt thoroughly into the grain of the meat. Let stand 24 to 48 hours. Again rub with the same mixture, sprinkling common salt freely between the layers. Cover also the top thickly with salt, and put over all a heavy weight—the heavier the better.

Or for ½ a barrel, or 100 pounds of beef, prepare a mixture of 4 quarts of coarse fine salt, 4 pounds of brown sugar, and 4 ounces of saltpeter. Rub thoroughly into the meat. Let stand 48 hours to drain, turning occasionally, and pack in layers under a heavy weight, sprinkling the above mixture between but without the addition of water. If a scum rises it should be taken off with a skimmer and a little fine salt sprinkled over the surface.

Or for the same quantity of beef, prepare a mixture of 6 quarts of coarse fine salt, 4 pounds of light "A" or coffee sugar, 6 ounces of soda, and 4 ounces of saltpeter. Cure in all respects as above.

Rusty or Tainted Meat.—If meat has been properly drained to free it from blood, the pickle boiled and clarified, the barrels scalded, and the meat kept under the pickle by means of a suitable weight, it should keep indefinitely. But it is quite customary, as a precaution, to pour off the pickling liquid on the approach of summer, say in April, in temperate climates. Again bring it to a boil, with the addition of about ½ pound of salt to each gallon of pickling liquid, and when cold, once more pour it over the meat through a cheese-cloth strainer. But this is said to harden the beef and injure its flavor. It is believed that if the meat is properly cured, this will not usually be found necessary.

If the meat should become tainted, pour off the tainted pickle and discard it. Rinse the meat with clear water and wash out the barrel with a strong solution of lime water or wood ashes. If the barrel is much tainted, it may be well to fill it with this solution and let stand overnight. Afterwards scald with boiling water.

Rub the meat in a mixture of saltpeter and sugar, and pack it between layers of charcoal. Finally, pour over it fresh pickling liquid, prepared as above, strong enough to float an egg.

Or mix 12 pounds of powdered charcoal, 10 pounds of common salt, and 4 pounds of saltpeter. Cover the bottom of the cask with a layer of this mixture, rub each piece with the same, and sprinkle it freely between the layers of meat. By either of these methods all traces of taint can be removed. The charcoal can be rinsed off with clear water.

Red Pickling Liquid for Meat.—To impart a fine red color to meat and to improve its flavor, dissolve in 8 gallons of pure soft water 8 pounds of bay salt, 8 pounds of common salt, 6 pounds of brown sugar, 1 pound of saltpeter, 8 ounces of bruised pimento, 5 ounces of bruised black pepper, and 2 ounces of grated nutmeg.

To Improve Corned Beef. — The quality of corned beef can be improved by immersing the pieces for half a minute by the watch, in boiling water before pickling. This is in accordance with the well-known practice of immersing beef that is to be boiled for the table in hot water in order to harden the surface, and cause the meat to retain its natural juices. Similarly this method tends to make corned beef more tender and juicy than otherwise. To effect this result first drain the meat to free it from blood, rinse it in clear water. Bring to a boil a solution of 2 ounces of saltpeter in 4 gallons of water and with a large fork having a long wooden handle, or a piece of wire having a hook at the end, immerse the pieces of meat for half a minute each in the boiling solution.

Or the same result may be obtained by pouring the pickling liquid while scalding hot over the meat; but the former method is to be preferred.

CURING HAMS, TONGUES, AND BACON

Pickling Mutton Hams.—First rub the hams with a mixture of 1 pound of salt, 1 ounce of saltpeter, and 1 ounce of sugar. Hang up for 24 or 48 hours to drain. Cover with a solution of about ½ pound of salt to 2 gallons of water, and let stand for 2 or 3 weeks. Pack closely in tubs or barrels and for each ½ barrel, or 100 pounds, prepare a pickle by dissolving 6 pounds of coarse fine salt, 2 ounces of saltpeter, 2 ounces of soda, 1 pint of molasses, and 1 pound of brown sugar in 6 gallons of pure soft water.

Pickling Tongues. — After trimming off the roots, with the exception of a little of the fat, rub the cut surface with a mixture of 1 pound of salt and 1 ounce of saltpeter. Sprinkle with the same and let drain for 48 hours. Now prepare a pickle by dissolving in 1 gallon of soft water 2½ pounds of bay salt, 2 ounces of saltpeter, and 1 pound of brown sugar. Bring to a boil over a slow fire, skimming constantly, and immerse the tongues in this.

Or mix 1 tablespoonful of salt, 1 tablespoonful of brown sugar and 2 tablespoonfuls of saltpeter to each tongue. Rub this well into the tongues twice a day for a week and let them stand in the brine. At the end of this time, add 1 additional tablespoonful of salt for each tongue and rub the pickle into them once a day for a week or 10 days.

Curing Pork Hams. — Pork hams may be cured either by dry- or wet-salting or pickling. It is then customary to smoke them, both to impart a smoky flavor and as a protection against insects. And they may be further protected by wrapping or sealing in cloth or paper cases.

To dry-salt hams for smoking, but without pickle, which is the English method, rub the fleshy parts thoroughly each day with fine table salt and hang up the hams for 3 or 4 days where they can drain. On the fourth day, rub well into the hams, using plenty of "elbow grease," a mixture of 1 pound of common salt, 1 pound of bay salt, 4 ounces of saltpeter, and ½ pound of brown sugar. Lay the hams on a board or shelf, rind side down, and each day apply to the fleshy side with a soft brush, a mixture of 1 pound of brown sugar and 1 pound of molasses. At the end of a fortnight, smoke with hickory wood or corncobs.

Or for each 100 pounds of pork, mix 1½ ounces of saltpeter, 1 ounce of black pepper, 5 ounces of brown sugar and 1 quart of common or bay salt. Add just enough hot water to dissolve. Mix all together and rub thoroughly into the meat. A woman's hands are not heavy enough to do this work properly. It is advisable to take out the bone and rub the inside of the ham where the bone is removed in the same manner. But if this is not done, the bone may be loosened slightly with a knife and the mixture forced into the cut for a few inches. Lay the hams with the fleshy side up and rub them over with this mixture every day for 10 days or 2 weeks, after which smoke them with hickory chips or corncobs.

Or for a wet-salting process, mix 1 pound of common salt, 1 pound of bay salt, 3 ounces of saltpeter, and ½ pound of brown sugar. Dissolve the saltpeter in a little boiling water, using no more than is necessary to dissolve it. Mix the other ingredients and rub the whole thoroughly into the fleshy side of the ham. Place them in a firkin or other tight receptacle and add for each ham 2 tablespoonfuls of pure vinegar. Each day turn the hams, and rub the brine into them thoroughly for a week or 10 days. Then let stand 3 or 4 days in the pickle, basting them occasionally with a large wooden spoon.

Or for each ham of 16 or 18 pounds' weight, mix 2 tablespoonfuls of saltpeter, and 4 ounces of brown sugar and rub it thoroughly into the fleshy side. After which cover the fleshy side with a layer of fine salt ½ inch thick, and lay the hams down in the tubs for 4 or 5 weeks.

Or mix 1 pound of bay salt, ¼ pound of saltpeter, ¼ pound of common salt, and ¼ pound of brown sugar. Heat to dryness, and rub well into the fleshy side of the ham. Lay it in a tub, barrel, or firkin, the rind side down. Cover the fleshy parts with a layer of this mixture and each day turn the hams, and rub the brine into them for a week or 10 days. Afterwards let stand for a month basting the pickle over them daily with a large wooden spoon. Hang up to dry for 2 or 3 days and smoke.

Or protect against insects, and store without smoking. A small ham will require about 2 weeks, and a large one 3 to 4 weeks to cure by the above method. A tongue will require about 12 days. They may then be used at once without drying, or may be dried and smoked.

Or if the weather is hot, and the hams show signs of rusting, make a pickle of common salt and water strong enough to float an egg, and

pour it over them.

Or to pickle pork hams, first rub them with a mixture of 1 pound of pure salt and 1 ounce of saltpeter. Sprinkle with same and let them drain on slats for 48 hours. Rub into each ham a mixture of ½ teaspoonful of saltpeter, ½ teaspoonful of brown sugar, and 1 salt spoon of Cayenne pepper. Scald a suitable tub or barrel. Cover the bottom with a layer of pure salt. Pack the hams in this, rind side down, sprinkling salt freely over the fleshy side of each, and let stand for a week. Prepare a pickling liquid by dissolving in 6 gallons of soft water 10 pounds of salt, 4 pounds of brown sugar, 4 ounces of saltpeter, and 2 ounces of soda. Bring to a boil with very gentle heat, skimming constantly. Set aside until cool, and pour into the cask through a cheese-cloth strainer. The hams should remain in this pickle from 6 weeks to 3 months, according to their size.

Or for 100 pounds of meat, dissolve in 4 gallons of soft water, 8 pounds of coarse fine salt, 1 ounce of baking soda, 2 ounces of saltpeter, and 2 pounds of brown sugar. Prepare in all respects as above.

Or for 100 pounds of meat, dissolve in 4 gallons of soft water 7 pounds of coarse fine salt, 2½ pounds of brown sugar, 2 ounces of saltpeter, and 2 ounces of soda. Immerse the hams and pickle for 2 or 3 months, according to their size.

Or rub the hams with a mixture of 1 pound of salt, 1 ounce of saltpeter, and let drain 3 or 4 days. Immerse in brine strong enough to float an egg, and for each ½ barrel or 100 pounds of meat, add 2 quarts of molasses, 4 ounces of saltpeter, 2 ounces of baking soda, and pickle 6 to 8 weeks.

Smoking Pork Hams.—Remove the hams from the pickling liquid and hang them up to drain and dry. When they have drained sufficiently, wipe them carefully with a sponge or clean cloth, and rub thoroughly into the fleshy side a mixture of equal parts of Cayenne and black pepper, especially about the bone and hock. This will prevent flies lighting upon them. Now sew up each ham in a bag of cheese cloth or scrim to protect it from soot, and hang up in the smoke house under a barrel or any suitable receptacle and smoke—the longer the better. Chips or sawdust from hickory or beech wood or corncobs are the most suitable fuel with which to smoke hams. After being lighted they must be kept smoldering by sprinkling them lightly with water

"Hang up Under a Barrel."

whenever they commence to blaze. And the process may be continued for 8 or 10 hours or for several weeks, according to convenience or the quality desired. Some persons who burn wood exclusively as fuel, smoke hams by sewing them up in a coarse cloth and hanging them up in the chimney, but this method is not suitable if coal is used as fuel in any part of the house. When hams are smoked properly the pyroligneous acid of the smoke permeates the meat. It also dries slowly at the same time. Quick smoking merely coats the outside of the ham, but does not penetrate its fiber.

Or an imitation of smoking may be had by immersing the ham in diluted pyroligneous acid for 2 or 3 hours, or giving it 2 or 3 coatings with a brush. But this method tends to harden and toughen the meat and is therefore not to be recommended for domestic use.

To Store Smoked Ham.—After removing hams from the smoke house, they may be rinsed in cold water, or better still, immersed for 2 or 3 minutes in boiling water, the effect of which is to cover them with a coating of grease and also to kill any germs or eggs of insects that may be present. Next, coat them with flour paste prepared by rubbing up 2 teaspoonfuls of flour in a little cold water, bringing to a boil, and stirring in 1 teaspoonful or more of Cayenne pepper. Cover the hams thickly with this paste by means of a soft brush, and hang them up in the direct sunlight until the paste dries. When dry, sew them up in coarse cloth, and give the cloth a coating of shellac or other varnish.

Or suspend them in a loose bag surrounded by finely chopped straw to the thickness of 2 or 3 inches.

Or place them in ordinary paper flour sacks. Tie tightly to exclude the air and insects and hang up in a cool, dark, well-ventilated place.

Or wrap each ham in ordinary brown butcher's wrapping paper, seal with paste containing Cayenne pepper, and tie with twine. Pack in packing cases or barrels in finely chopped straw. A coating of pyroligneous acid, if carefully applied, so as to cover the entire surface and penetrate all crevices, will effectually prevent contamination of insects.

Curing Bacon. — The process of curing bacon is similar to dry-smoking pork hams. Rub the flitches of bacon with 1 ounce of common salt, 1 ounce of saltpeter, and 1 ounce of brown sugar. Lay them on slats or slanting boards to drain for 48 hours, turning frequently. Next lay the flitches in a deep dripping pan, and cover with the same mixture. Turn and rub the pickle into them 2 or 3 times a day for a week or 10 days. Let stand in the pickle for about 3 weeks in all, basting them frequently with a large wooden spoon. Remove and smoke as for hams. Place in paper flour sacks and tie tightly to exclude the air and preserve from insects.

MAKING AND KEEPING SAUSAGE

Sausage.—Fresh pork, beef, and other meats may be preserved in the same manner as sausage meat by seasoning them highly with spices and packing them in air-tight cases, or in earthenware or other tight receptacles, and running over them a layer of melted lard or tallow to exclude the air.

Intestine Cases for Sausage.—Remove from the pig's intestines the loose fat and outer membranes.

Turn them inside out and cleanse them thoroughly in borax water. Bleach by letting them soak for 24 hours or more in water containing 1 ounce of chloride of lime to the gallon. Rinse thoroughly in clear soft water and scrape or tear off a part of the inner lining until they are as thin as may be without tearing or puncturing them. Finally, wash them thoroughly several times in warm water.

Seasoning for Sausage.—Salt, pepper, and sage, according to taste, are ordinarily used for seasoning sausage. Summer savory is also frequently used, and other spices, as allspice, cloves, ginger, etc., are sometimes recommended. But, as a rule, salt, pepper, and sage are sufficient, and will be preferred by most persons. The proportion of seasoning recommended varies and it is a good plan in mixing sausage meat, to fry a little of the meat after seasoning and add more of the ground meat or seasoning, as desired, until the flavor is satisfactory. The following are all tested recipes, and by comparison, a selection may be made according to whether it is desired to have the sausage highly seasoned or not:

For 10 pounds of ground sausage meat, use 4 ounces of salt, $\frac{1}{2}$ ounce of pepper, and $\frac{3}{4}$ ounce of sage.

Or for the same quantity, 5 tablespoonfuls of sage, 4 tablespoonfuls of salt, and 2 tablespoonfuls of pepper.

Or for each pound of meat, 1 heaping teaspoonful of salt, 1 of pepper, and 1 of sage, with the addition to each 3 pounds of meat, if desired, 1 teaspoonful each of allspice, ginger, and summer savory.

Or for over 25 pounds of meat, 12 ounces of salt, 2 ounces of sage, and 2 ounces of pepper.

Or for 10 pounds of meat, 4 ounces of salt, 1 ounce of sage, and 1 ounce of pepper.

Grinding Sausage Meat. — The trimmings of the hog's carcass are ordinarily ground into sausage meat, the proportion of fat and lean being varied according to taste. Some prefer $\frac{1}{3}$ fat meat to $\frac{2}{3}$ lean. Others $\frac{1}{4}$ fat to $\frac{3}{4}$ lean.

To Prepare Sausage.—To prepare good sausage, it is desirable to have a sausage grinder or suitable meat cutter, although the sausage meat can be chopped in a wooden tray with a chopping knife or on a block by means of a heavy knife or cleaver. It will be found easier in mixing the spices thoroughly into the meat to dry and pulverize them as finely as possible, cut the meat into rather small pieces and sprinkle the spices over it before it is ground. It will thus become thoroughly incorporated with the meat in grinding. The sausage grinder is ordinarily fitted with a device for filling the cases. If link sausage is to be made, care must be taken not to fill the sausage cases too full, but to pinch and twist them at intervals to make them link properly.

Or sausages may be packed in cases of muslin or other clean white goods about $2\frac{1}{2}$ or 3 inches thick, forced in by means of a clean round stick of hard wood, laid down in jars, and covered with brine or melted lard.

Or the cloth cases may be dipped in melted lard and hung up to dry, care being taken that they have a uniform coating of lard to exclude the air.

Or the sausage meat may be laid down in earthenware pans 4 or 5 inches deep, and a coat of melted lard $\frac{1}{4}$ to $\frac{1}{2}$ inch deep poured over them to exclude the air. As long as the coating of lard is not broken, the sausage meat will keep indefinitely. Or if the dish is not too large, it will usually keep after being opened until required for family use. Or after slices have been removed for use, the open end can be covered with a coating of melted lard until more is needed.

"A Coat of Melted Lard."

Or large earthenware jars may be used for this purpose, although, in most cases, they are not as convenient.

To Improve Sausage Meat.—The addition of about $\frac{1}{10}$ by weight of ground beef to pork sausage, is preferred by many, as it makes the sausage less greasy and firmer in texture.

Or for immediate use, powdered bread crumbs at the same rate may be added for this purpose. But this should not be used if the sausage meat is to be laid down for a long time as it will not keep so well.

Bologna Sausage. — The so-called bologna sausage is a mixture of approximately equal parts of pork and beef or other meats highly seasoned and packed in large cases, 3 to 6 inches in diameter, obtained from the intestines of beeves. The following mixtures are recommended:

Grind up together in a sausage machine or meat cutter 4 pounds of beef and 2 pounds of pork free from fat or gristle, to which add 6 pounds of fresh fat pork cut in thin strips and chopped on a block by means of a heavy knife or cleaver into pieces about $\frac{1}{4}$ of an inch square or less. Season this quantity with 8 ounces of salt, $\frac{1}{8}$ ounce of saltpeter, 8 ounces of coffee sugar, and $\frac{1}{2}$ ounce of bruised pimento. To exclude the air, the cases must be packed with as much pressure as they will stand without bursting, and this may be done by tying them at the bottom and pressing in the meat with a round block of wood or pestle, nearly but not quite large enough to fill the inside of the case. If the meat is not packed tightly enough, the sausage will not keep.

Rub the outside of the cases with salt butter. Tie them tightly at both ends and hang up to dry for 3 weeks, then smoke as for hams or bacon.

Or cut into small pieces an inch or two square 3 pounds of pork, $1\frac{1}{2}$ pounds of beef free from fat or gristle, and 1 pound of clean fresh beef suet. Sprinkle with a mixture of spices consisting of 3 ounces of salt, 3 tablespoonfuls of black pepper, 2 teaspoonfuls of Cayenne, 1 teaspoonful each of cloves and allspice, and a small onion chopped fine. If the meat cutter is coarse, run through a second time and pack tightly in cases 4 or 5 inches in diameter. Knot both ends and cover with strong brine for a week or 10 days. Change the brine and let stand another week. After which dry and smoke them as for hams or bacon. Rub the cases

with butter and store them in a cool dark place.

Mixed Sausage. — Cut in small pieces equal parts of fat pork, lean pork, lean veal, and beef suet. For each 6 pounds of meat add the rind of a lemon grated, a small nutmeg grated, ½ ounce of powdered sage, 2 teaspoonfuls of butter, 4 teaspoonfuls of salt, and 1 teaspoonful of summer savory. Pack in cases or lay down in jars and cover with lard.

Beef Sausage.—In summer, when fresh pork is not obtainable, raw beef may be ground up with beef suet in the proportion of about 1 part of suet, 2 parts of lean beef, and the whole seasoned with 1 teaspoonful each of pepper, salt, sage, and summer savory ground through the meat cutter or sausage grinder, and made into cakes to be fried, or laid down in earthenware pans under a coating of lard until required for use.

Pickled Tripe.—Empty the paunch by turning it wrong side out, taking care not to let any of the contents get on the outside. Rinse with cold water. Tie or sew up the openings tightly with strong cord so that the lime water cannot get inside, and immerse it in a tub of cold fresh slaked lime about as thick as whitewash. Let it stand 15 or 20 minutes, or until the dark outside skin is loosened and can be readily pulled off. Pass through 3 or 4 rinsing waters. Tack up on a board and with a dull knife scrape off the dark surface until it looks clean and has no offensive odor. Soak for half an hour in hot water, then scrape with a dull knife and repeat until perfectly white and clean. Immerse in strong brine and let stand 3 or 4 days, changing the water each day. Cut into pieces a foot long and 6 inches wide, and immerse in buttermilk for 3 or 4 days to whiten. Rinse and lay down in a suitable cask. Cover with pure white wine or cider vinegar, or spiced pickling liquid as preferred.

PRESERVATION OF COOKED MEAT

In addition to the preservation of fresh meat in various ways, cooked or partially cooked meats may be preserved for considerable periods of time by canning or taking other means to exclude the air. Meats to be canned are first cut into suitable pieces, boiled until tender and packed in glass jars surrounded by boiling water. The meat jelly, or "aspic," in which they have been cooked, is then seasoned to taste and poured over them, boiling hot, until the jar is filled to the brim, and they are then sealed while hot. The addition of the aspic, which is, of course, melted when the cans are sealed, but which solidifies on cooling, not only assists in preserving the meat, but also improves its flavor.

Or suitable tin cans may be used. The cans, surrounded with hot water, are packed with the cooked meat, and the meat jelly poured over them. The cover is then soldered in place, a small hole is punctured in it and the water surrounding the can is boiled until steam escapes from the aperture. The opening is then closed with solder. The condensation of the steam inside the can on cooling produces a vacuum by which the sides of the can are made slightly concave. And if at any time this concavity disappears, or the sides of the can swell so as to become convex, it is a sure indication that the contents were not properly preserved and have become putrid.

Or to preserve pork chops or sliced ham for summer frying, pickle fresh pork about 10 days or 2 weeks and fry it until about half done.

Or remove the hams from the brine in April, slice, trim, and fry them until half done. Pack the chops or hams separately in solid layers in stone jars. Let them cool, and when entirely cold, pour over them their own fat with the addition of a little melted lard, so as to cover the surface with a layer ½ inch or more thick. Place over the top of the jar a layer of cotton batting. Put on the lid tightly and store in a cool place until required for use. After taking out a portion of the meat for use, remelt the lard and pour back over the meat to exclude the air. Lamb or veal chops, beefsteak or sausage meat may be laid down in the same manner.

Preserving Cooked Sausage.—Pack sausage in cases, or sausage meat, into a small crock or bean pot about ⅔ full. Place in a baking oven and bake about fifteen minutes for each pound of sausage, i. e., for 6 pounds of sausage bake an hour and a half. Remove from the oven and set aside to cool. When cold, fill the crock with melted lard. Throw over the top a layer of cotton batting, put on the lid, and store in a dark, cool place until required for use.

Or fried sausage can be laid down in the same manner and covered with its own grease.

Or for cooked bologna sausage, grind together 2 pounds each of pork, bacon, beef, and veal free from fat or gristle, and 2 pounds of beef suet. First cut in small pieces and sprinkle over it before grinding 4 ounces of salt, 6 tablespoonfuls of black pepper, 1 tablespoonful of Cayenne, and pack tightly into beef cases 4 or 5 inches in diameter. Form links about 12 or 15 inches in length, tying at both ends. Prick the skins and boil for about an hour. Hang up to dry for 2 or 3 days and afterwards smoke with hickory wood or corncobs.

Or grind up together with suitable seasoning equal quantities of ham, veal, or pork; or ⅓ pork and ⅔ beef. Cook and smoke as above.

Potted Beef.—Cut 3 pounds of lean beef into pieces weighing about ¼ of a pound each and sprinkle over them a mixture of ½ pound of table salt and ½ ounce of powdered saltpeter. Let the beef lie in this pickle 2 or 3 days, turning the pieces occasionally. Remove the meat from the pickle, place it in a stone jar, or pan covered, if convenient, with a little beef gravy or just enough cold water to prevent burning. Put an earthenware plate over it and bake in a slow oven for about 4 hours, or until the meat is very tender and falls away from the bones. Remove the meat from the gravy. Shred or chop it fine, moisten it with the gravy and pound it in a marble mortar or otherwise with a little fresh butter to a very fine paste. Season to taste with pepper, allspice, nutmeg, mace, or cloves. Or add, if desired, Cayenne, Tabasco, curry powder, or anchovies, mustard, or other condiment, according to taste. Press tightly in small crocks or jars, or in fruit jars. When cold, pour over the tops of the jars melted lard or butter to a thickness of ¼ inch, and cover with a layer of cotton batting tied tightly on any cover that will exclude the air.

Pressed Beef.—Or select about 5 pounds of cheap beef that would otherwise be too tough to cook, including about ¾ of a pound of beef fat. Cover with a mixture of ¾ pound of salt and ½ ounce of saltpeter and

let stand for a couple of days turning it now and then, and rubbing brine into it. Rinse in clear water and boil until it falls from the bones, taking care that when boiled down, the gravy will be as thick as possible. Remove the beef from the gravy with a skimmer and chop fine. Allow the gravy to cool. Take off the cake of fat, and dissolve ½ ounce of gelatin in the gravy with gentle heat. Spice to taste. Stir in the chopped meat. Pack in jars under a weight and pour melted lard or butter over the top to the depth of ½ inch or more. If carefully preserved from the air, this will keep for a considerable time at ordinary temperatures, and may be sliced and eaten cold without further cooking.

TRYING OUT AND STORING LARD

Lard.—The leaf fat which adheres to the ribs and belly of the hog make the so-called "leaf lard," which is of the best quality. Hence it is a good plan to try out the leaves separately. But any part of the hog fat not used for other purposes may be tried out to make an ordinary quality of lard. A set kettle, or other large kettle, held over a camp fire by means of a tripod out of doors on a clear, calm day, is the best utensil for this purpose. Cut the fat into small pieces 1 or 2 inches square, and add 1 ounce of soda for each 25 pounds of meat. Stir frequently as soon as the fat melts and the scraps begin to brown. Melt with very gentle heat, taking care not to allow the fat to smoke or burn. Toward the last, the lard must be stirred constantly to prevent burning. The lard will be done when the steam ceases to rise. When the scraps are brown and shriveled, throw in a little salt to settle the sediment, and strain through a cheese-cloth strainer into tubs or jars. Tie over the tops a layer of cotton batting to exclude the air. Lard will keep better in small jars than in large ones. Good lard should be white and solid without any offensive odor. Store in a cool, dry place. The lard from the intestines will not keep as well as leaf lard, hence should be rendered separately. It will keep better if soaked for 3 or 4 days in strong brine changed each day.

Bleaching Lard.—The addition of about 1 pint of boiled white lye from hickory ashes, strained through cheese cloth into the fat before boiling, tends to bleach it.

Adulteration of Lard with Water.—The addition of 3 to 5 per cent milk of lime, allows about 25 per cent of water to be mixed with lard while cooling, thus greatly increasing its weight and volume. The presence of water may be perceived by the sputtering made in melting the lard. Also, the water will collect in the bottom of the vessel and the lard will float on its surface. This test will often show that the purchaser is paying for a considerable percentage of water instead of lard.

Cod Fat.—The suet taken from the beef flank is called cod fat. It makes a much softer and better fat than the common suet. Obtain the best looking pieces of cod fat from the butcher, free them from veins or spots and melt with very gentle heat. Pour the melted suet into clear cold water, iced water, if convenient, to harden. Pour off the water, remove all dampness with a clean dry cloth. Wrap up the fat in waxed paper and store in a cool, dry place.

Cottolene. — This substitute for lard or suet consists of 6 parts cotton oil, 4 parts oleostearine. Melt together with very gentle heat and run through a filter in jars. This is preferred by many to animal fat, being purer as well as cheaper.

PRESERVING, TESTING, AND PACKING EGGS

Preservation of Eggs.—More hens' eggs are laid during the months of March, April, May, and June than during the other 8 months of the year. Hence the bulk of the consumption of eggs during the fall and winter months is of eggs that are not fresh laid. The commercial method of preserving eggs is by means of cold storage in vaults kept at a temperature of 40° F. or less. Eggs are collected all over the United States and stored in the largest cities, whence they are distributed at wholesale and often times sold in the winter months to farmers and others who keep hens, but who are not, at that season, getting enough eggs for their own consumption. The wholesale market recognizes seventeen grades of eggs according to their size, weight, and freshness and the localities from which they come. But the ordinary buyer of eggs is unable to distinguish among them, and often gets a very much cheaper grade of cold-storage egg than she pays for. Hence on all grounds, it is much better and cheaper for those who keep chickens to preserve, in the season when eggs are plentiful, all that are not required for immediate use. If care is taken, eggs if perfectly fresh when preserved will be nearly, if not quite equal to new. But at all events, home-stored eggs, if properly preserved, will be superior to cold-storage ones, which are often far from fresh when gathered and placed in storage.

Testing Eggs.—Eggshells are porous or perforated right through by minute holes for the admission of air needed by the chick for breathing. Hence in time a part of the liquid contents of the egg evaporates. The white and yolk shrink and the resulting emptied space is filled with air. This space is normally at the broad end. And this is the reason why, in

"Look Through them at the Light."

storing eggs, the point should always be downward. To test eggs take a candle or electric light or lamp in an otherwise dark room and fit it with a candling chimney, which may be obtained at any poultry store or may be readily made from a piece of cardboard. This is merely a cylinder of cardboard large enough to surround the candle or the lamp chimney, and having a tube inserted at right angles somewhat smaller in diameter than an ordinary egg, and about the level of the flame. Through this the egg

can be observed against the light.

To test eggs, hold each one up against the opening of this cylinder, broad end upward, and look through them at the light. If the contents do not fill the shell, the egg is not perfectly fresh, and the larger the air space the older is the egg. The yolk should be perfectly clear and round in outline. If, besides the air space, there is a dark haze or cloud in the egg, it has become spoiled. If the cloud contains a black spot, the egg is bad. All storage eggs show some shrinkage, and eggs shipped by freight from distant points to a wholesale market, will shrink on the way even if not afterwards preserved in cold storage.

Methods of Preserving Eggs.—The object to be secured in preserving eggs is to prevent the evaporation of their contents, and thus prevent the air coming in to fill the space. This may be accomplished by any method of filling the pores of the shell so as to effectually prevent the passage of air. Among the substances recommended for this purpose are mucilage made of gum arabic or gum tragacanth dissolved in water; albumen, or the white of egg; collodion, linseed oil, paraffin; shellac, or other varnish; saltpeter, lard, sugar sirup; finely powdered gypsum, or plaster of Paris, dry salt, and various solutions, as lime, soda, saltpeter, salt, etc., in water.

As the object of all these methods is the same, it becomes merely a question of selecting whatever substance is most readily obtainable and whatever method is most convenient under the circumstances. Hence to preserve eggs, dissolve with gentle heat 1 ounce of gum arabic or gum tragacanth in 1 pint of water, and if too thick, thin with boiling water to the consistency of common mucilage. Remove the mucilage from the fire, allow it to cool and apply it with a soft brush. Have at hand large sheets of blotting paper or a bed of dry sand on which to rest the eggs while the mucilage is drying. If laid on wood or any other hard substance, the mucilage will cause them to stick and they cannot be removed without chipping the shell. After laying down the eggs take care to cover the finger marks where the egg was held. When dry, pack, with the small ends down, in pails, tubs, or cases in dry bran, meal, or flour. Do not use salt with gum arabic or tragacanth as, by attracting moisture, it may cause them to dissolve. If a little of the blotting paper or sand adheres to the egg it will do no harm. When the eggs are required for use, the mucilage can be removed with cold water, taking any foreign substances with it.

Or beat up the white of an egg with a saltspoonful of salt, and apply in the same manner.

Or apply shellac or copal varnish.

Or apply by the same method a thick coating of collodion dissolved in alcohol, or a coating of paraffin or of linseed oil.

Or place in the palm of the hand a little salt butter or pure salted lard, and turn the egg about until every portion of the surface has been covered with the grease. Thus a small amount of lard or butter will cover a large number of eggs. Pack with the small ends down in bran or other substance as described above.

Or pack eggs, greased with salted lard or butter, between layers of common salt. Take care to store in a perfectly dry, well-ventilated place where the eggs will not freeze. Eggs thus stored can be preserved for several months.

Or for home use, dip the egg for 10 or 20 seconds into boiling water. This forms a thin coating of albumen inside of the shell that partially closes the pores. Remove from the boiling water and dip into a thin sugar sirup made by dissolving 5 pounds of brown sugar in a gallon of water, and set aside to dry. Small quantities of eggs may be dipped in these liquids by means of a colander or suspended in a wire or wicker basket. But take care to shake them slightly so that every part of the shell will be exposed to the solutions. When dry, pack as above.

Or to preserve eggs for a longer period of time, they may be immersed in a solution of lime with other substances, in water. The celebrated English patent of Jayne consisted in slaking fresh stone lime in a wooden tub or barrel with just enough water to dissolve it, and afterwards thinning with cold water to a point that will just float a fresh egg. Then, for each bushel of lime, stir in 2 pounds of salt and ½ pound of cream of tartar. Immerse the eggs and keep them below the surface by means of a floating cover of wood weighted just enough to rest upon the eggs without crushing them.

Or for a small quantity of eggs, the same recipe would require about 1 ounce of salt, ¼ ounce of cream of tartar, and 1 quart of lime.

Or a standard American recipe consists in packing the eggs with the small ends down, in a crock or firkin, and covering them with a cold solution of 1 pound of lime, 2 ounces of salt, and ½ ounce of saltpeter, dissolved by stirring in boiling water and allowed to stand overnight before using.

Or to 3 gallons of water, add 1 pint of fresh slaked lime, ½ pint of common salt, and 2 ounces of saltpeter.

Or a more elaborate recipe calls for 4 pounds of fresh stone lime to be slaked in 12 gallons of water. Stir in 2 pounds of salt and let stand for 24 hours. Decant the pure lime water without disturbing the sediment. Dissolve separately in one gallon of boiling water 2½ ounces of soda, 2½ ounces of cream of tartar, 2½ ounces of saltpeter, 2½ ounces of borax, and 1 ounce of alum. Mix this solution with 10 gallons of the pure lime water. Pack the eggs, point down, in suitable tubs or casks, and cover with this liquid. They must be kept below the surface by means of a cloth or wooden cover and suitable weights. This quantity is sufficient for about 75 dozen eggs. The same proportions may be observed for smaller quantities.

Or pack the eggs in stone crocks, points down, and pour over them melted lard as cool as it will blow, or just before it sets, and allow it to harden about them.

Packing Eggs.—To pack eggs for transportation, layers of newspaper or any soft, cheap paper that may be available will be found safer than oats or bran. Crumple a number of newspapers, and lay them in the bottom of the box or basket, and bring them up well around the sides. Pack the eggs close together so that they cannot roll against each other. Lay over them 2 or 3 thicknesses of paper, on this another layer of eggs, and so on. Throw over the top 2 or 3 thicknesses of coarse burlap and fasten it around the outside of the package with cord. Eggs packed in this way

in a clothes basket may be driven in a wagon over the roughest roads without breaking.

Or to pack for market, obtain an egg case, manufactured for this purpose, which will serve as a model for making cases at home. Or they can be made at trifling expense by the local carpenter. It will be found that the cost of these cases will be more than repaid in convenience and in preventing breakage.

Pickling Eggs.—Prepare a spiced pickling liquid the same as for spiced cucumber or other pickles.

Or boil in a cheese-cloth bag for 15 or 20 minutes in 1 quart of white wine or pure cider vinegar, 1 ounce of raw ginger, 1 ounce of allspice, 2 blades of mace, 1 ounce of pepper, 1 ounce of salt, 3 or 4 cloves of garlic, and 1 ounce of mustard seed. Boil for this quantity of pickle, a dozen eggs for 10 minutes. Place to cool in a pan of cold water. Remove the shells, pack them in a crock, and when perfectly cold, pour the pickling liquid over them. Lay over the top a folded cloth to keep the eggs under the pickling liquid, and tie over the top of the jar a thickness of cotton batting. They will be ready to use in about 4 weeks.

Dried Eggs.—Break any quantity of eggs in a suitable receptacle, and beat them well with an egg beater. Spread out in a thin layer on a clean earthenware platter, and let them dry into a paste. Pack closely in glass jars and seal.

Or pour the beaten eggs into glass jars and set the jar in a pan of hot water at about a temperature of 125° F. until the moisture is evaporated and the egg becomes hard. Seal until required for use. They can then be dissolved with about 3 times their own bulk of cold water, and beaten up together, when they will be found to have retained much of their original flavor.

STORING AND PRESERVING VEGETABLES, FRUIT, NUTS, AND HERBS

Conditions that cause vegetables to decay are moisture and heat, or frequent and extreme changes of temperature, as alternate freezing and thawing. These conditions are also favorable to the attacks of insects. Cold storage in a dry vault, with a temperature near or below the freezing point, is, of course, the best method. Coöperative cold storage plants, both large and small, the benefits of which may be shared by a group of neighbors or an entire community, are likely in time to come to be very numerous. But if cold storage is out of the question, a cool, dry place, where the temperature is likely to be as even as possible, should be sought for most vegetables.

Vegetable Pits.—To preserve root crops—as beets, turnips, and parsnips, also cabbages—dig a trench on the north side of a sandy slope or ridge where the drainage is as perfect as possible, so that after a storm no water will stand in the trench. Dig a trench two or three feet deep about the same in width, and any desired length. Pack the vegetables carefully in this. Pile them up in a pyramid like the ridge of the roof of a house. Cover with a layer about a foot thick of meadow hay or straw and throw enough earth lightly over the straw to keep it in place. After the first frosts in the fall cover with a layer of earth 5 or 6 inches thick, and in the latter part of November or about the 1st of December, cover solidly with earth to the depth of a foot or more. Remove the vegetables from one end as required for use and cover the opening with hay or straw and keep it in place with boards, or shovel snow over it.

Ventilate these pits by means of 6-inch tile drains or square boxes of 6-inch boards nailed together. Insert these ventilators at intervals of 25 or 50 feet in large pits and plug the opening with loose straw to keep out the frost. Otherwise there is danger of decay from moisture in the event of an early thaw.

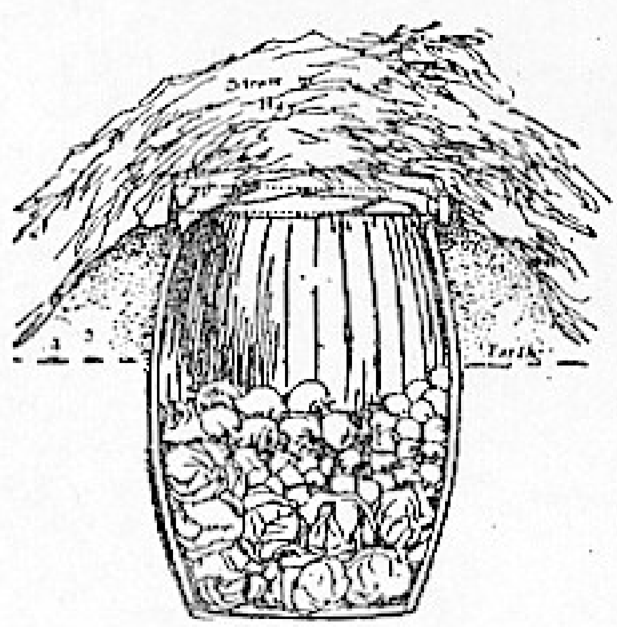
Or pull root crops, as turnips, beets, and the like on a hot, dry day and let them lie in the sun until all dirt can be shaken from the roots. Twist off the tops, leaving the tap root on. Pack them in clean, dry barrels or bins and fill with fine dry sand or road dust, shaking it down around them until the box or barrel is full. Root crops should not be packed on the floors of cellars, as dampness is likely to cause them to decay and furnish breeding places for bacteria that cause filth diseases.

To Keep Celery.—In the latter part of October dig a trench 18 inches deep and 12 to 15 inches wide on a dry, well-drained ridge. Loosen the earth about the roots of the celery and draw out the stalks without shaking off the soil that adheres to them. Stand them upright close together in the trench inclining slightly toward the middle, and draw the earth around them up to the tips. Cover with a thick layer of leaves, straw, or meadow hay, put a board across the top and weight with stones or otherwise. If there is any danger of standing water from rains or melting snow, in winter, dig a ditch deeper than the celery trench for drainage.

Vegetable Cellar. — To preserve small quantities of vegetables for domestic use, sink a half hogshead, cask, or large dry-goods box about two-thirds of its depth into the ground and slope the earth around it on all sides to the top. Knock the bottom out, and line the space with loose brick laid on the earth side by side or with a layer of loose stone. Fit it with a water-tight cover coming down over the edge.

Pack in this such vegetables as cabbage, celery, beets, turnips, etc. They will keep fresh all winter.

When cold weather comes on, throw over the top a large bag of burlap or potato sacking made like a mattress



"Sink a Cask in the Earth."

and filled loosely with hay or straw. This can readily be removed to allow access and replaced after required vegetables have been taken out for use.

To Store Onions.—Pull the onions and let them lie in the field until the tops are withered. Spread them under cover on an open floor or on slats until they are bone dry.

The best receptacles for onions are

at boxes having solid heads of inch pine stuff, with sides and bottoms of rough laths, the width of one lath open between every two. These should be made to hold a bushel or half a bushel. Stack them one above the other, with pieces of inch pine stuff between to admit of free circulation of air. Pack these in a cool cellar on a platform raised 8 or 10 inches from the cellar bottom.

Or stack them in a shed or outhouse. Make a bin around them of rough boards about 6 inches from the outside of the crates, and fill the space with chopped straw, chaff, or sawdust. Cover over the top with sand and throw over the whole any old burlap, carpet, or canvas that may be at hand. Thus protected it will do no harm if the onions freeze, as chaff or straw is a nonconducting material, and they will not thaw out until spring, and then very slowly. The same would be true in an ordinary cellar.

Or small quantities may be packed in barrels or boxes in chaff or sawdust, and stored in a dry attic which is not heated in winter.

To Keep Parsnips.—Parsnips may be left in the ground all winter in temperate climates, or in very severe climates they may be buried in a deep pit in the garden.

Or pull them late in the fall, leave the tips on, and lay them side by side in rows and cover with 6 or 8 inches of coarse straw, leaves, or chaff. Freezing tends to improve their quality.

Salsify.—Like parsnips, salsify is improved by freezing and hence may be preserved in the same manner.

Turnips.—Turnips are not injured by freezing. Hence they may be packed in small crates, boxes, or barrels placed in an outhouse and covered with straw to exclude the light and to prevent their thawing readily. Or they may be buried in trenches or packed in boxes or barrels between layers of fine earth and allowed to freeze.

Beets.—Beets may be stored as for onions, but should be kept in a dry place and at as uniform a temperature as possible. In small quantities they may be stored in any suitable receptacle in sand or dry moss.

Squashes and Pumpkins. — These vegetables are very susceptible to frost and moisture. Hence they should not be placed in cellars or outhouses. Hung by the stem from the ceiling in a warm, dry storeroom the hard-shelled varieties will keep practically all winter.

To Store Tomatoes. — Pack green tomatoes in lath crates and store in a cool, dry storeroom away from the frost.

To Store Potatoes.—Potatoes are usually stored in bins or barrels in a dark cellar. They should not be left in the field any longer than is necessary to dry them after being dug, as they are injured by exposure to direct sunshine. It is advisable to cover the bottom of the bin or barrel with a layer of fine, dry sand, throw over the top a piece of burlap and place a layer of sand on this. They should be examined once or twice a month during the winter, and if they commence to rot should be picked over, care being taken to handle them carefully so as not to bruise them.

To Keep Potatoes from Sprouting. To keep old potatoes not intended for seed from withering and sprouting, place them in a sack or handled basket and lower them into boiling water for a minute or two, moving them about so that the water will reach all parts of the surface. Lay them out on a flat surface to dry thoroughly before storing them away. The boiling water kills the germs.

Potatoes thus treated will continue practically as good as new until new potatoes come in. By this process old potatoes can be held over until the market price is at its height.

Or they can be preserved for domestic use when there are only new potatoes at high prices on the market.

To Store Sweet Potatoes.—Pack in boxes or barrels on a very hot day in summer in clean, dry sand. Take care that the potatoes do not touch one another, and place in a dry storeroom where the temperature will range between 40° and 60° F. Care must be taken not to bruise them, and they must be bone dry when packed. Small quantities procured from dealers in winter may be kept in sand near the kitchen stove, or in any warm, dry place.

To Store Cabbage.—Cabbages are not injured by frost, but wither and wilt in a drying heat. Hence they should be kept in a cool, dark, and moist place, but must not be kept in standing water, as it injures their flavor, or packed together, else they will heat and rot.

Cut them before the severe fall frosts, leaving about 2 inches or more of the stem attached. Let the outside leaves remain on. Tie a strong cord about the stalks, and hang them from the timbers of the ceiling of a cool, dry cellar, heads downward. Several cabbages may be suspended on one cord one above another, and in this way a large number can be stored in an ordinary cellar, just enough space being left among them to admit of a circulation of air.

Or pack in sawdust in large casks or packing cases. Take care to have a layer of several inches of sawdust between the cabbages and the box. Put them in any outhouse and let them freeze. Sawdust being a nonconductor, they will not thaw out until spring, and will not be injured.

Or cabbages may be stored out of doors by loosening the earth about the roots and pulling them up without shaking off the dirt which adheres. Now set them out in furrows, burying the roots just as they grow up to the head in soil. Let the heads touch. Drive posts in the ground, build a shed roof over them of rough boards or poles high enough so that there will be circulation of air between the roof and the cabbages, and cover the roof with corn fodder or straw. Pack straw or meadow hay around the sides to keep out the snow, and let them freeze. They will keep green and fresh all winter.

Sauerkraut. — Sauerkraut consists of sliced cabbage laid down between layers of common salt—at the rate of about one pint of salt to a barrel of cabbage—in a wooden tub or firkin, and with the addition of black pepper, anise, mustard, caraway, or celery seed if desired.

Thoroughly scald the tub, firkin, or cask. Remove the outer leaves of the cabbage and use them to line the cask. Slice the heart of the cabbage fine by means of a slaw cutter or sharp knife. Place a layer of clean leaves on the bottom of the cask. Sprinkle over them a small handful of salt and put in a layer of sliced cabbage about 6 inches in depth, using the outer leaves as a lining to keep the sliced cabbage from the sides of the cask. Sprinkle over the cab-

bage a small handful of salt, and by means of a wooden beetle or the end of a round stick of hard wood, pound the cabbage until it is a solid mass, or until the juice just makes its appearance, but do not pound or salt the cabbage too much. Now add another layer of cabbage and another handful of salt, and so continue pounding down each layer solidly until the cask is nearly full.

Cover the top over with the loose outer leaves, and lay over these several thicknesses of cheese cloth. Lay on a loose cover of boards and on this a weight of stone equal to 25 or 30 pounds. Let the cask stand in a warm place for three or four weeks, during which it will ferment and give off at first a very disagreeable odor. After forty-eight hours, if brine has not been formed, add a little salt water, about as salt as tears, to cover the cabbage. After two days more, add more salt water, if necessary, until brine forms over the top of the board cover and a scum appears. Remove the cloth cover, taking the brine with it, rinse thoroughly in cold water, wring dry, and return to its place. Continue to do this every few days until it ceases to ferment. This will require four or five weeks. It is then ready for use and may be stored in any cool, dark place.

Sauerkraut is usually made in the fall for winter use, but if it is desired to keep what is left for use in summer, squeeze out the brine through cheese cloth. Select a suitable earthenware jar, sprinkle the bottom with salt and pack the sauerkraut in this. Make a brine by dissolving 1 tablespoonful of salt to a quart of cold water. Bring to a boil over a slow fire removing the scum as it rises. Set aside to cool and pour over the sauerkraut. Lay over the top several thicknesses of cheese cloth, and tie over the jar a piece of cotton batting. This will keep until the hottest days of summer.

Cauliflower. — In a well-drained part of the garden dig a ditch 12 or 15 inches deep and 12 inches wide. Pack the cauliflowers in this with the roots down and cover with earth up to the heads. Fill the trench with hay or straw 6 or 8 inches thick, and weight it down with stone, earth, or boards.

Or pack the cauliflowers on the cellar bottom, burying the roots and stalks in earth. In this way they can be kept until the 1st of March or later.

To Store Green Beans.—Pack down green string beans in glass jars between layers of salt. Seal the jars. When required for use, freshen in clear water for several hours, changing the water frequently.

To Store Green Peas. — Select shelled peas that are full grown but not hard and dry them in a dripping pan in a very slow oven or on the back of the stove. Let them dry slowly, stirring them frequently, and do not have them too thick in the pan. Continue the heat until they are hard and dry as bone. Pack in glass or stone jars. Seal and keep in a dry place. Let soak overnight in cold water before boiling.

To Store Dry Beans.—Dry shelled beans should be stored in a dry, cool place, and will not require protection unless they become infested with bugs. In that case place the beans in a coarse sack or basket and dip them in boiling water for a minute or two. Hang up to drip dry and they will not only be free from insects but will also keep better.

To Store Lima Beans.—Gather lima beans before they ripen, and while they are still tender and green. Spread them on cloths in the sun to dry.

To Dry Peas.—Pick over the peas and remove any pods that are mildewed or spotted. Spread the pods to dry on cloths in the sun.

To Store Peas.—Store shelled peas in any dry place. They will keep unless they become infested with weevils. In that case put them in a tin dripping pan, cover, place in a slow oven and heat until the weevils are killed.

To Dry Corn.—Cut the corn raw from the cob and dry it thoroughly in pans in an oven. This gives a finer flavor than when it is partly boiled.

Or dip green corn on the ear in boiling water, remove, and hang up the ears until dry in a room where there is a free circulation of air.

Or husk and clean the silk from the corn. Place the ears in a colander over a kettle of steaming water, and steam a half hour or more. Split the kernels with a sharp knife, scrape out the pulp and dry it on clean tins or earthenware platters. Care must be taken not to scorch or brown it.

Or husk and clean the corn, shave off the kernels with a sharp knife, scrape the remaining pulp from the cobs, and lay on earthenware platters. Sprinkle ½ teacupful of sugar to each 3 quarts of corn, stir well and place in a medium hot oven for ten minutes, but do not scorch or brown it. Remove and spread to dry in a drying rack or under a hotbed sash. It should be dried as quickly as possible as it deteriorates with exposure. Store in tight jars or boxes in a dry place. When required for use soak it in lukewarm water.

Preserving Green Peas.—Shell and pick over the peas. Cover them with cold water and bring to a boil. Pour them into a sieve or colander to drain. Crush the pea pods in a saucepan or run them through a meat cutter, and pour over them a little of the water in which the peas were boiled. Pack the peas into glass jars. Salt the juice from the pea pods to taste, pour it boiling hot over the peas and seal.

Or shell and pick over the peas, place them in a kettle of cold water and bring to a boil for two or three minutes only. Remove from the boiling water and let them drip dry. Now spread them out on a cloth on a table or other smooth surface. Lay over them another dry cloth to remove all moisture. Pack them in jelly tumblers or fruit jars, and pour over them clarified butter or mutton suet to the depth of an inch. Tie over the top a piece of cotton batting and store in a cool place until required for use.

Or shell and pick over the peas when full grown, but not hard, and dry them in shallow earthenware plates in a slow oven. Stir frequently and let them dry slowly. When they are hard, set them aside to cool and pack them in stone jars covered with cotton batting. Soak in cold water when required for use.

To Dry Pumpkins. — Prepare the ripe fruit, cut into cubes about as large as the rind is thick, discarding the inner pulp and seeds. Cook until soft and squeeze through a colander. Dry in a slow oven with the doors open, on earthenware plates covered to the depth of about an inch. This will require eight or ten hours. Store the sheets in a dry place and soak overnight in milk when required for use.

To Dry Rhubarb.—To dry the stalks of rhubarb, first strip off the outer skin with a sharp knife. This is a painstaking process, but it pays as the rhubarb dries more quickly and thoroughly. Spread on cloths in the sun, preferably under a hotbed sash, and dry as quickly as possible.

To Cure Rhubarb Root.—Pull up the roots from the old rhubarb bed when a new bed has been set out. Brush off the earth with a dry brush, and cut the roots into squares 2 inches long. Take off the skin with a sharp knife. Bore a hole through the middle and run a string through them, knotting it so as to keep each piece of root separate from the others. String these between suitable posts or pegs upon the ground, and expose to the sun to dry. Take them indoors at night or when it rains, as dampness is apt to cause mold.

To Dry Parsley.—To have bright, crisp parsley, pick it in dry weather. Spread it thinly on a platter and bake it in a moderate oven with the doors open, turning frequently. If the oven is not too hot, the leaves will become dry and brittle without losing their green color. Take care that the heat is not sufficient to turn the leaves brown or they will be spoiled. Now rub it to powder between the palms of the hands, pick out the stalks, sift the powder through a coarse sieve, place it in a glass bottle or jar and cork tightly. Keep in a dry place. A peck or more of the parsley should be gathered, as it is reduced very much in bulk by drying. The dry powder is suitable for most purposes for which fresh parsley is employed, and is much more convenient.

To Dry Herbs.—Herbs should be gathered in dry weather, carefully picked over and dried as quickly as possible, either in a slow oven or under a hotbed sash. They should be spread out thin on sheets of blotting paper and turned occasionally. Fresh herbs are, of course, to be preferred, but as they are not obtainable in winter it is necessary to preserve them by drying.

The season at which herbs are best fit to be preserved by drying varies with different species. Orange flowers, elder flowers, parsley and chervil in May, June, and July; burnet and tarragon in June, July, and August; knotted marjoram and mint in July; summer savory, July and August; basil, winter savory, and lemon thyme, the end of July and August.

The aromatic herbs must not be exposed to too great heat, as otherwise the essential oils which give them their flavor will be volatilized. After being dried, the herbs should be screened through a large sieve to remove dust and other impurities, the stems removed, and the leaves stored in glass bottles. All of the above herbs will be found useful condiments in cookery, and several of them have medicinal qualities. These and many others can also be obtained of druggists and other dealers.

To Gather Roots.—Most medicinal and other roots should be gathered in the spring and are, as a rule, better in the fresh than in the dry state. To dry them it is only necessary to brush off the dust with a dry brush, rinse the roots in cold water, string them together and expose them to the heat of the sun or in a slow oven until bone dry.

Lath Boxes for Vegetables and Fruit.—Cut end pieces of inch thick pine stuff 14 inches long and 12 inches deep. Cut laths 17½ inches long which will give two pieces for each lath. Tack these laths to the end pieces to form two sides and the bottom, having the thickness of one lath between every two. Cut holes about 3½ inches long and 1 inch or more deep in the two ends about 3 or 4 inches from the top as handles, and use these boxes for picking up apples, potatoes, onions, and other vegetables, and storing them for winter use.

Packing Fruit. — Carefully pick over the fruit and discard all windfalls, and specked or wormy specimens. For an extra fine quality, wrap each fruit in tissue paper. Pack in clean, dry, flour barrels and pour over the top dry sand or road dust, shaking it down until the barrel is full. Place the barrels in a cellar or other cool place where they will not freeze.

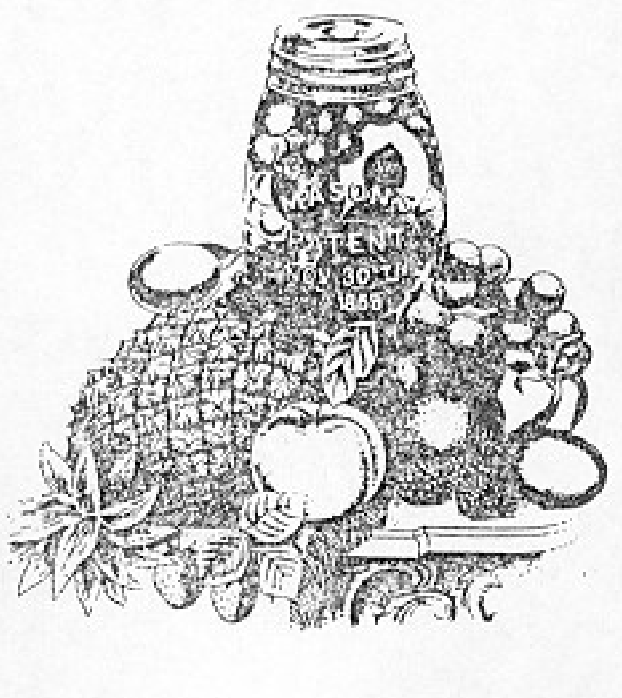
Evaporated Apples. — To dry or evaporate apples, peel and core them and cut across in thin slices. Let the slices fall into cold water to prevent their rusting. When all are sliced, and in readiness, lay the slices on a large piece of cheese cloth and baste them to this by means of a darning needle and suitable cotton thread, taking a stitch through each slice, so that it will lie flat and keep in place. Suspend the cheese cloth out of doors by the four corners to suitable stakes, high enough to be out of the reach of small animals, spread another thickness of cheese cloth over the fruit and expose to direct sunlight. Be sure to take them in before dew falls. When sufficiently dry store them in a dark place. This is the cheapest and most convenient way to dry apples, and the color will be nearly equal to that of the commercial article.

Or thin trays or slats about ¼ of an inch in width may be tacked together, the apples spread on these and covered with cheese cloth to prevent the fruit turning dark.

Storing Nuts. — Pack walnuts in jars, boxes, or casks between layers of fine dry sand. If they have become shriveled, let them stand overnight in skimmed milk or a solution of milk and water. Chestnuts and filberts may also be stored in the same manner.

Almonds. — Buy for domestic use the sweet almond, as the bitter almond contains prussic acid which is a deadly poison. To freshen almonds place them while still in the shells in a colander set in a basin of cold water and bring to a boil. Lift them out, peel them as quickly as possible and drop the kernels into cold water. Never leave almonds in boiling water to cool as it is likely to make them bitter.

To roast almonds for salting or bonbons, put them in an ordinary corn popper and shake them over a brisk fire.



VINEGAR, PICKLES, AND PICKLING

SPECIAL VINEGARS—PICKLES AND PICKLING—MIXED PICKLES—PICKLED VEGETABLES, NUTS, AND FRUITS

All vinegar, of which there are several kinds, consists of a dilute solution of acetic acid in water with a small amount of sugar and other organic matter. Vinegar is the result of the action of the oxygen of the air, in the presence of a particular kind of yeast or ferment, upon a solution of alcohol. The alcoholic liquors from which vinegar is made may be produced by the fermentation of almost any vegetable or fruit juices. The principal kinds of vinegar are, accordingly, wine vinegar, produced from grapes; malt vinegar, from barley; cider vinegar, from apples; sugar and molasses vinegar, from cane sugar products; corn vinegar; beet vinegar; etc. The alcoholic fluid, or "wash," as it is called, should contain not over 4 per cent to 12 per cent of alcohol. And for the best results the temperature should be from 70 per cent to 85 per cent Fahrenheit. Plenty of air to introduce the oxygen required by the process must be supplied and mixed with the alcoholic solution. The changing of alcohol to acetic acid by the action of oxygen produces heat and increases the weight of the liquid.

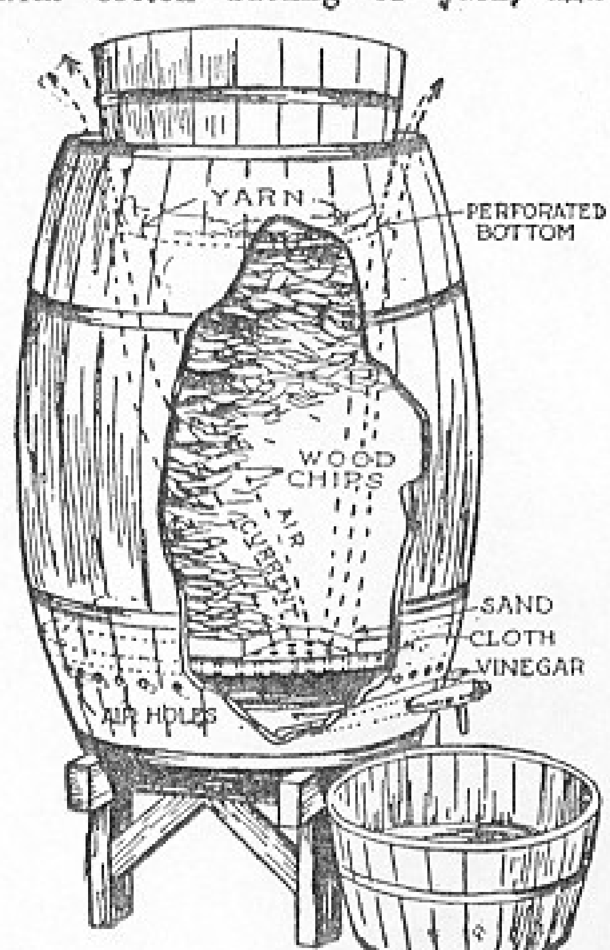
Commercial vinegar is made on the Continent of Europe principally from cheap grades of wine, in England from malt and sour beer, in the United States from cider and cheap grades of alcoholic liquors, as whisky and the like.

Methods of Making Vinegar. — There are two principal ways of making vinegar — the slow and the quick process. In the former the alcoholic solution is placed in a barrel or vat containing a little old vinegar or mother, which supplies the necessary yeast, or in the case of wine vinegar, old wine lees, either exposed to the sun or placed in a warm room. Air is admitted through the bung of the casks or otherwise, and the liquid is allowed to stand until it turns to vinegar. This takes two weeks or more in summer, and a month or more in cold weather. The process is similar to that of making cheap vinegar from molasses and yeast, or making ordinary cider vinegar.

Or to make vinegar by the quick, or German process, prepare a special contrivance as follows:

Supply a large vinegar cask with a false bottom about a foot from the true bottom perforated with a large number of $\frac{1}{4}$ inch gimlet holes. If a fine quality of vinegar is desired, cover this with one or more thicknesses of white flannel cloth, and an inch layer of clean white sand on top. Bore, around the outside of the barrel an inch below the false bottom, a row of $\frac{1}{2}$ inch auger holes slanting downward from without 2 or 3 inches apart. These are necessary to admit the air. Fill the barrel from the false bottom to within 4 or 5 inches of the top with maple, beech, or basswood chips previously soaked for three or four days in first-class vinegar.

Now cut another cask of somewhat smaller size in halves. Bore the bottom of one half barrel full of gimlet holes the size of a goose quill or about $\frac{1}{8}$ inch in diameter. Cover this with cotton batting or yarn, and



"Vinegar by the Quick or German Process."

place it on top of the barrel resting on cross slats or upon the chips.

Insert a spigot into the cask below the false bottom, slanting downward to the bottom of the cask but having its opening just below the level of the row of air holes, and place beneath the spigot the other half barrel, protected by a wooden cover from dust and dirt.

The alcoholic liquor poured into the upper half barrel causes the yarn or cotton in the bottom to swell and fill the gimlet holes, whence the liquor drops through upon the chips. The process of fermentation produces heat, which causes a current of air to rise through the openings for that purpose below the false bottom, and to meet the alcoholic liquor as it percolates drop by drop through the chips. The air current escapes between the bottom of the upper half barrel and the top edges of the large cask. Thus the action of the oxygen in the air in turning the alcohol into acetic acid is made very rapid.

The vinegar, after passing through the sand and flannel strainer, and the false bottom, accumulates in the bottom of the barrel but cannot escape through the spigot until it reaches the level of its mouth, or a depth of 8 or 10 inches. It is then first drawn from the bottom where its strength is greatest. And the strong vinegar thus accumulated assists in the process of fermentation.

To use this apparatus, pour in about 4 gallons of alcoholic liquor or "wash" every hour with the addition of 1 quart to make up for the waste. And withdraw every hour about 4 gallons of vinegar from the bottom. The first product must be ladled back into the upper half barrel, run through again and again, when it will be converted into vinegar in three or four days. It must then be poured into a clean tank or cask, and one or two quarts of molasses added to it each day, until the molasses settles in a bed 3 or 4 inches thick. This improves the flavor of the vinegar and gives it a fine color. This process is the quickest and most satisfactory that has ever been devised. And as the apparatus is inexpensive, and the

product is more salable than ordinary vinegar, there would seem to be no reason why it could not be utilized by grocers and other dealers in vinegar, or by private families or individuals either for domestic use or for sale.

Water for Vinegar.—Pure soft or distilled water ought to be used for the manufacture of good vinegar, and if the water is not pure it should be purified by filtering through charcoal.

Wash or Liquors for Vinegar.—The commonest alcoholic liquor used for commercial vinegar in this country consists of about 3 gallons of corn whisky, 4 gallons of good commercial vinegar, and 33 gallons of pure water.

Or 50 gallons of 60 per cent whisky and 37 gallons of beer or maltwort.

Or 2 gallons of brandy, 4 gallons of vinegar, and 12 gallons of water, with the addition, to promote fermentation, of about 1 gallon of an infusion of equal parts bran and rye meal.

Or use 1½ pounds of sugar to each gallon of pure water.

Or ½ gallon of water to 2 gallons of cider. Add to the above in all cases 2 quarts of yeast to every barrel of the liquor.

To Ferment Vinegar.—The process of making vinegar requires the presence of the minute vegetable organisms called yeast, and is greatly hastened by conditions favorable to their growth. This is the reason that vinegar is made more rapidly in hot than in cold weather, and that the temperature of 75° to 80° F. hastens the process. The germs of yeast are, of course, present in large numbers in the lees and mother of old vinegar and also in the vinegar which is soaked into the fiber of the cask. Hence an old vinegar barrel, if sound, is preferable to a new one. The germs of yeast are also present in ordinary vinegar, and if 1 gallon of sound vinegar can be added to each 3 or 5 gallons of cider or other alcoholic liquor or "wash" from which vinegar is to be made, no other yeast will be necessary.

Or good brewers' yeast may be added to the alcoholic liquor at the rate of about ¾ of a pint to each 12 gallons.

Or homemade hop yeast at the rate of 1½ pints to 12 gallons. The "wash" should be at a temperature of about 75° or 80° F. when the yeast is added, and should be kept at or near that temperature while the vinegar is being made. Yeast must not be scalded as a temperature above 140° F. kills it. When old vinegar barrels are employed, or ordinary vinegar is put into new casks to hasten fermentation, care must be taken that the vinegar formerly made in the casks, or used for this purpose, is of the same kind and of at least equally good quality to the desired product. That is, if a fine quality of cider vinegar is desired, only casks that have been used in making pure cider vinegar, or the best grade of cider vinegar itself should be used in the process.

Or boil until tender 1½ pints of shelled corn to each gallon of the "wash" and add this in place of yeast to promote fermentation. When the vinegar is sour enough, strain it through cheese cloth to remove the corn and let stand another week to clarify.

Money in Vinegar.—Grocers and other merchants who sell vinegar at retail should make their own vinegar. They can thus, by employing only the best materials, guarantee a pure article. They can also materially increase their profits. In fact, any person living in the country or small town, can profitably manufacture vinegar for family use and also, if desired, by producing a pure and genuine article can build up a neighborhood trade. To do this it is only necessary to leave samples, with price attached, at the neighboring houses and keep always on hand a sufficient quantity of first-class vinegar. The commercial article is so often adulterated with injurious acids that most persons will prefer to buy homemade vinegar at the market rates or better and a satisfactory profit will be assured.

Cheap Molasses Vinegar.—To make vinegar by the slow process, fill a large jug, keg, or cask with a mixture consisting of 1 quart of best New Orleans molasses, 1 pint of yeast to each 3 gallons of warm rain water. Tie a piece of cheese cloth over the bung to keep out dust and insects, but to admit the air. Place the receptacle out of doors in the sun during hot weather. Or in cold weather let it stand near the kitchen stove. It will be converted into vinegar in from three weeks to a month. When it gets low, draw off a supply for family use, leaving more or less old vinegar with the mother and lees in the bottom of the cask. Fill up with new liquid in the same proportions, and let stand until converted into vinegar as before.

Or dissolve ½ a pound of light-brown "A" or coffee sugar in 2 gallons of soft warm water. Add 3 pints of homemade hop yeast or 1½ pints of good brewers' yeast to each 12 gallons. Pour a l into a suitable keg or cask.

Or a firkin may be used if fitted with a tight cover having one or more auger holes to admit air through it. Fill the receptacle about two thirds full, or a little more, so as to expose as large a surface as possible to the air. Cover the openings with cheese cloth and let stand in a warm place. Where the conditions are favorable it will be converted into vinegar in about two weeks or a month.

Or for a somewhat better quality, take 5 gallons of water to 1 gallon of molasses, and add a quart of yeast. The addition of a gallon of good vinegar will hasten the process. Odds and ends of sirup, as rinsings from fruit jars, molasses cans, and the like, may be added to the liquor from time to time.

Or for a cheaper quality, take 25 gallons of warm rain water, 4 gallons of molasses, and 1 gallon of brewers' yeast.

To Manufacture Vinegar for Sale.—Grocers and other merchants who sell vinegar at retail may keep themselves supplied with vinegar in the following manner:

Have on hand three or more barrels in multiples of three, and use them in rotation. If less than a barrel of vinegar is sold each week, three barrels will be sufficient, as the process will be completed in three weeks or less. Commence with a barrel of good commercial vinegar. Before it is quite empty draw off and pour into each of the other two barrels 2 or 3 gallons of vinegar. Now fill up the vinegar barrel with a fresh liquor in the proportion of 1 gallon of molasses to 5 gallons more or less of warm rain water according to the quality of vinegar desired, and about

1 quart of yeast for each 12 gallons of the mixture.

Fill up the other two barrels with the same liquor. The first or old vinegar barrel containing more or less lees and mother will turn to vinegar very quickly, and may be sold first, and refilled when it gets low. By that time the second will be ready to use, or nearly so. After the three barrels are once started, if filled up when nearly emptied, they will furnish a constant supply.

Or if upward of two barrels are sold each week, six casks may be kept going in the same manner. A good-sized bunghole should be kept open to admit the air, but they should have two or three thicknesses of cheese cloth tacked over them to keep out dust and insects.

Or to manufacture vinegar on a large scale summer and winter alike, it is necessary either to have a large cellar equipped with suitable vats or casks, or a building which is well ventilated, and can be warmed in winter by means of a furnace or otherwise. In addition to suitable arrangements for storing ordinary casks in tiers, and the necessary apparatus for leaching the wash through beechwood shavings by the quick or German process, an important part of the equipment is one or more large ripening casks or vats capable of holding 500 to 1,000 gallons and upward. The cider or other "wash," after having been turned into vinegar by either the slow or quick process and run off into smaller casks, should be transferred at intervals to these large casks so that the output of the establishment will be of a uniform flavor. Care must, of course, be taken that the casks, vats, and other apparatus used to produce a particular kind or grade of vinegar should not be used for any other purpose, if the object is to build up a trade for a particular brand or quality.

Malt Vinegar.—In the vicinity of breweries, where wort can be procured at a reasonable price, malt vinegar can be made very cheaply. Add to each 25 gallons of wort 1 gallon of beer yeast. Ferment for about thirty-five or forty hours, and draw off the liquor into casks about two thirds full. Let them stand at a temperature of 70° to 75° F. Keep the bungs out to admit plenty of air.

Sugar Vinegar.—To make sugar vinegar for domestic use, add ½ pint of yeast to a solution of 1¼ pounds of sugar in 1 gallon of water. Let the mixture ferment for about three days in a large earthenware jar or other receptacle, placed where the temperature will be at least 80° F. Then draw off the clear liquor from the sediment into a clean cask and add 1 ounce of cream of tartar and 1 ounce of bruised raisins. Let stand until sufficiently sour, clarify, bottle and cork for use.

Or boil any quantity of coarse brown sugar with filtered rain water at the rate of 2 pounds of sugar to the gallon and with a skimmer remove the scum as fast as it appears. Now add a quart of cold water for every gallon of hot. Let cool, and add about a pint of yeast for each 6 gallons of the liquor. Run into a cask. Cover the bunghole with wire gauze or several thicknesses of cheese cloth, and place it out in the sun. If this vinegar is made in the early spring and exposed to summer heat it will be ready for use by midsummer. In winter six months will be required.

Cider Vinegar.—The best quality of vinegar is undoubtedly that made from cider, providing the apples used are sound, ripe, sweet fruit. As the best grades of cider vinegar bring a fancy price, it is advisable to separate ripe, sweet windfalls from small, unripe, or defective fruit, and use the best fruit for an A 1 grade of cider. The usual careless method of making cider is merely to fill a cask to its capacity with cider and let it stand four to six months to sour. But, with proper care and attention, a better grade of cider can be made in a much quicker time. The better way is to place the cider in a hogshead or large tank. Lay the ripening casks, with the bungholes open, on their sides, exposed to the heat of the sun or in a warm cellar, and fill them at first only about a quarter full of cider. After about two weeks, add another quarter, making the barrel half full, and after two weeks more do the same, leaving the cask about three quarters full. Thus a considerable flat surface inside is left exposed to the air. Once a day for the first few weeks draw from the spigot a gallon or more of cider and pour it from a considerable height through a funnel into the bunghole. This keeps the cider full of air. Also, put into each barrel a pound or more of bread dough, prepared as for making ordinary wheat bread, in the state in which it is ready to be put into the oven.

Other methods recommended for hastening the process of fermentation are the addition of a quart or more of molasses to each cask, 2 ounces of brown sugar to each gallon of cider, or brown paper dipped in New Orleans molasses. But the bread dough is perhaps to be preferred. The ordinary skunk-cabbage balls, which occur plentifully in swamps and meadows in many localities, are also employed for this purpose.

Or the mother of vinegar from an old cider barrel will greatly hasten the process.

Cheap Cider Vinegar. — Save the pomace from which cider is made, or buy pomace from the cider mill. Put it into tight casks or hogsheads with the head knocked out of one end and a spigot near the bottom, and cover with filtered rain water. Tack over the top two or three thicknesses of cheese cloth to keep out insects and dust. Draw off the liquor from the bottom as fast as it ferments, and use it to dilute pure cider. Thus nearly two barrels of vinegar can be made from one of cider.

To Make Cider Vinegar Quickly. —Fill a jar or jug with cider and add for each gallon of cider a pint of New Orleans molasses and a cupful of good yeast. Take out the cork of the jug or leave the cover of the jar tilted slightly to admit the air. The cider will commence to ferment at once and will be turned into vinegar in about a week. Pour off the clear into demijohns or bottles and cork tightly for use. Leave the lees or mother, and fill up the original receptacle with fresh cider to repeat the process.

To Preserve Vinegar.—To preserve vinegar after it has ripened to perfection, draw it off from the mother into a clean cask and drive in the bung to exclude the air.

Or clarify and bottle it in tightly stoppered bottles and store at a low temperature. If it again thickens and shows traces of mother, it must

be once more drawn off into a clean vessel.

Grape Vinegar.—The juice of the grapes must first be extracted in a wine press and allowed to ferment. Wine when a year old usually furnishes the best vinegar, as with greater age the wine loses a part of its organic matter and becomes unsuitable for vinegar. To make vinegar from wine it is first poured into a cask containing wine lees. It is then placed in cloth sacks in an ironbound vat or cask and squeezed through the cloth by means of weights from above. It is then placed in upright casks having a bunghole at the top and allowed to sour, same as cider vinegar. If casks are exposed to the summer sun, the contents turn to vinegar in about two weeks. But in winter the process in a warm room requires a month or more. The temperature should be 75° to 86° F. The wine is next drawn off into barrels containing beech-wood chips, to clarify for about two weeks. It is then ready for use. The original cask, containing the residue of mother, is used without cleansing to ferment additional wine.

In making the best qualities of vinegar the wine is first clarified by running it into casks or vats containing beech shavings. The ripening casks are then filled about a quarter full of boiling vinegar, which is allowed to stand for three or four days, after which the wine is gradually added at the rate of about a gallon at a time until the casks are filled. After about two or three weeks the wine is turned to vinegar. One half is then drawn off and bottled or stored for use, and the cask is refilled as before. This process is sometimes continued for ten years, without the casks ever becoming more than half empty, but after that length of time it is necessary to remove the accumulated sediment.

White-Wine Vinegar. — Crush 2 pounds of clean juicy raisins. Add a gallon of filtered rain water, place in a 2-gallon jug uncorked, and let it stand in a warm place. In about a month it will be converted into pure white-wine vinegar.

Pour out the clear vinegar through a cheese-cloth strainer, leaving the raisins and sediment in the jug; add ½ pound of raisins in another gallon of water, and repeat the process.

Corn Vinegar.—Boil in a gallon of rain water a pint of shelled Indian corn until the kernels burst. Pour the whole into a 2-gallon stone jug and add filtered rain water to supply that lost by evaporation, making a gallon all told. Dissolve ½ pound of granulated sugar in ½ pound of soft water by bringing it to a boil. Pour into the jug; shake well. Cover the mouth of the jug with two or three thicknesses of cheese cloth. Let stand in a warm place at a temperature of 75° or 80° F. It will be converted into vinegar in about a month. Pour off this vinegar into another jug, leaving about half the mother, and repeat the process.

To preserve this vinegar, cover the mouth of the jug with a piece of cloth and store it in a dry, warm place. This recipe makes vinegar about as cheaply as it can be made, and gives a quality that is preferred by many to ordinary cider vinegar. It is worth trying.

To Clarify Vinegar.—To clarify vinegar for bottling, draw it off into a clean cask or other vessel and throw into it a handful more or less of shredded isinglass. Let it stand for a few days and filter through a cheese cloth.

Distilled Vinegar.—Vinegar is distilled by heating in an ordinary retort by means of a sand bath, about 7 pints being carried over from each gallon. No lead or pewter can be used in any part of the retort or condenser, as the acetic acid acting upon these metals produces a poisonous compound. Distilled vinegar is weaker than the ordinary commercial article for the reason that water boils at a lower temperature than acetic acid. Hence more water than acetic acid is carried over. Distilled vinegar is used principally by druggists.

To Decolorize Vinegar. — Substances recommended for this purpose are ivory black, bone black or ordinary charcoal, all of which have the property of absorbing the various coloring matters so as to reduce ordinary cider, red wine, or other highly colored vinegar to a limpid and transparent whiteness.

Mix with each gallon of red wine or cider vinegar about 6 ounces of pure bone charcoal, from which, by means of a coarse sieve, all loose dust and small grains have been removed. Place the whole in a glass or earthenware vessel and shake or stir from time to time until the color has been removed.

Or the charcoal, in the same proportion, can be thrown into an ordinary cask, and the contents stirred occasionally.

Or if the cask is bunged up, the cask may be rolled or rocked, or ended up from time to time, to bring the charcoal in contact with all parts of the vinegar.

Or a double bag of any desired size may be made of coarse linen and lined with a layer of charcoal 2 or 3 inches in thickness. This should be quilted sufficiently to prevent the charcoal from settling or bunching up. Vinegar may be decolorized by straining through this.

Strength of Vinegar.—The strength of vinegar or the amount of acetic acid which is contained in different specimens, differs greatly. To determine the proportion of acetic acid, suspend 4 or 5 ounces, by weight, of broken pieces of fine marble in 16 ounces, by weight, of vinegar. The acetic acid will attack the marble and will be gradually neutralized. Let stand overnight. Remove the marble, rinse it in cold water, dry it thoroughly with gentle heat on top of the stove (but take care not to melt it), and weigh it carefully, ⅝ of its loss in weight is the quantity of actual acetic acid contained in the sample. And from this amount the proportion of acetic acid can be readily obtained.

Good vinegar should contain about 5 per cent of absolute acetic acid. The commercial test is the number of grains of pure carbonate of potassium that will exactly neutralize 1 fluid ounce of vinegar. If 20 grains of carbonate of potassium are required, the sample is known as 20-grains' strength.

Purity of Vinegar.—Various mineral acids, as sulphuric, nitric, hydrochloric and others, are sometimes added to vinegar as adulterants to increase its acidity, and for other purposes. Red pepper, mustard, and other acrid substances are also used, and traces of copper and lead are sometimes derived from the vats or kettles in which the vinegar is prepared.

Test for Sulphuric Acid.—Stir into a sample of suspected vinegar a small quantity of potato starch and bring to a boil. Remove from the fire and let stand until entirely cold. Add slowly, drop by drop, a solution of iodine. If the vinegar is pure, the iodine solution will produce the blue color of iodide of starch, but if sulphuric acid is present the starch will have been converted by boiling into dextrin, and the blue color will not appear.

Or dip a piece of writing paper in the vinegar and heat it over the stove; if the vinegar is pure, the paper will not be charred, but the presence of 2 per cent or more of sulphuric acid will char it.

Or a more delicate test consists in bringing to a boil a solution of ½ ounce of sugar in 16 ounces of water and when it reaches the boiling point dipping into it a china cup or saucer. If a drop of vinegar is let fall on this china surface while moistened with sirup at the temperature of boiling water (212° F.) if pure it will produce no perceptible effect. But if it contains the slightest trace of sulphuric acid it will produce a spot of color ranging from pale green to a darker brown or black in proportion to the quantity of free sulphuric acid present.

Test for Hydrochloric Acid.—To test for hydrochloric acid use the boiled potato-starch and solution-of-iodine test for sulphuric acid; the reaction will be the same.

Or add to the suspected sample a little silver nitrate, which, if hydrochloric acid is present, will produce a white precipitate.

Test for Nitric Acid.—To test for nitric acid, add a solution of indigo to the sample of vinegar and bring to a boil. The nitric acid can be detected by a yellow color.

Tests for Other Adulterants.—To discover the presence of red pepper, mustard, etc., boil down the vinegar until all the water it contains has been evaporated, when, if these substances are present, the resulting extract will have a sharp, biting taste.

To test for copper, add potassium ferrocyanide, which will give a brown precipitate.

To test for lead, add hydrogen sulphide, which will give a black precipitate, or potassium iodine, which will produce a yellow precipitate.

To Strengthen Vinegar. — To strengthen a quantity of weak vinegar, boil down a gallon of good vinegar to 2 quarts, and let it stand in the sun for a week or ten days. Add this to about six times its own bulk of weak vinegar. The whole will be strengthened and given an agreeable flavor.

SPECIAL VINEGARS

Aromatic Vinegar.—This is a mixture or compound of strong acetic acid or ordinary vinegar with various essential oils. It is a volatile and powerful perfume having a pungent odor and is snuffed in the nostrils as a stimulant in languor, faintness, nervous debility, etc.

To produce the best qualities of aromatic vinegar, a glacial or crystallizable acetic acid is combined with various essential oils at the rate of 6 drops, more or less, of the oils of clove, lavender, rosemary, calamus, etc., to 1 ounce of glacial acetic acid.

Aromatic vinegar must be kept tightly corked. For use it may be dropped on a sponge or snuffed from a vinaigrette. It may also be used as a caustic for warts, corns, and other callouses. But on account of its caustic properties it must be carefully kept from clothing and the skin. Treat accidental burns with cooking soda.

Imitation of Aromatic Vinegar.—Common vinegar may be boiled down with very gentle heat until 90 per cent to 95 per cent of its bulk has been lost by evaporation, and the remainder will be almost pure acetic acid. To this the essential oils may be added in the above proportions, and a fairly good grade of aromatic vinegar obtained.

Fruit Vinegars. — The juices of most ordinary fruits, as raspberries, currants, gooseberries, and the like, contain sufficient sugar to ferment and produce an alcoholic liquor from which vinegar can be made, either with or without the addition of sugar sirup or molasses.

To make vinegar from fruits, extract the juice by boiling the fruit with about its own quantity of water. Squeeze out the juice through several thicknesses of cheese cloth. This may be done by inserting sticks at either end and twisting them. To each gallon of fruit juice add about a quarter pint of good yeast, and let stand in an open jug or jar with the cover slightly tilted at a temperature of 70° or 80° F.

Or the boiled fruit juice may be allowed to stand for two or three days, to ferment before straining. And the yeast may be added after the fermented liquor has been freed from the fruit pulp.

Vinegar made from fruit juices is of better quality and keeps better than that made from malt liquors. These juices are often prepared in much the same manner before they are fully turned into vinegar and used as cooling drinks. And ordinary vinegar is frequently flavored with fruit juices for table use. The following include miscellaneous recipes of these kinds:

Raspberry Vinegar.—Pick over 1½ pints of fresh raspberries. Place them in an earthenware jar or jug, and pour over them 3 pints of pure vinegar. After twenty-four hours strain out the liquor, discard the fruit pulp, clean the jar, place in it 1½ pints of fresh raspberries, and pour the liquor over them. After another twenty-four hours repeat the process for the third time, thus using, all told, 4½ pints of fresh raspberries. Decant the clear liquor through two or three thicknesses of cheese cloth, without squeezing, into a double boiler of graniteware, porcelain, or tin. But do not use a graniteware kettle that is chipped so as to expose the iron. Stir in until dissolved 1 pound of crushed loaf sugar for each pint of liquor. Boil for one hour, taking off the scum with a skimmer as fast as it appears. Bottle, cork, and seal.

Gooseberry Vinegar.—Mash in a suitable vessel half a bushel of ripe gooseberries. Using for this purpose the end of a stick of hard wood. Add 6 gallons of lukewarm rain water, and let stand twenty-four hours. Strain through several thicknesses of cheese cloth, stir in 12 pounds of coarse brown sugar, and pour the whole into a 9-gallon cask, filling it up with warm rain water. Let stand three or four days, stirring several times a day to dissolve the sugar, which settles at the bottom. Head up the cask, pack two or three thicknesses of cheese cloth over the bunghole, and place the cask in a warm place, near the kitchen stove indoors,

but not in the sun. It will be turned into vinegar in from nine to twelve months. It may then be strained and bottled for use. When so made gooseberry vinegar is superior to the best white-wine vinegar, and will make a better quality of pickles than the most expensive vinegar of commerce, preserving the ingredients better, whereas the cost is next to nothing.

Or for each quart of ripe gooseberries, add 3 quarts of water, ferment forty-eight hours, strain, stir in 1½ pounds of sugar, and let stand in a warm place ten months or more, when it will be ready for use.

Raspberry, corn, and other fruit vinegars may be made by the same plan, and substantially the same proportions may be observed.

Horse-Radish Vinegar. — Mix 1½ ounces of horse-radish, ½ ounce of minced shallot, ½ ounce of Cayenne pepper or paprika, and pour over it a pint of vinegar. Let stand a week or ten days, strain through cheese cloth and bottle for use.

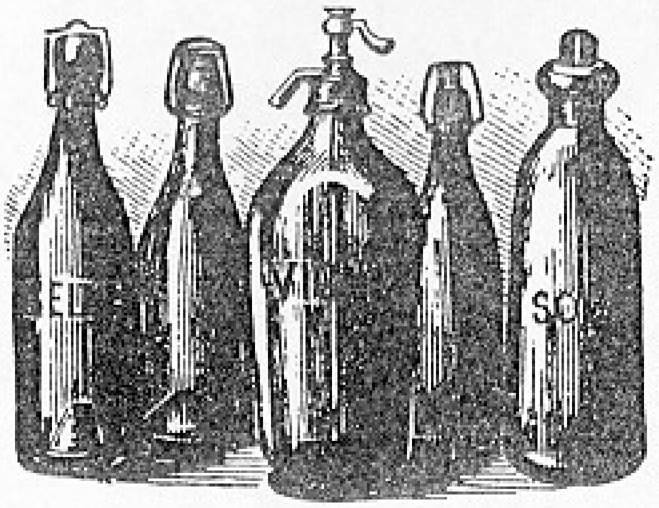
Cucumber Vinegar. — Place in a large stone jar about 1½ dozen large cucumbers, pared and sliced, 4 large onions, pared and sliced, 2 or 3 pieces of garlic and shallots, 2 tablespoonfuls of salt, 3 tablespoonfuls of black or white pepper, and ½ teaspoonful of paprika or Cayenne. Let stand four or five days, bring to a boil, cool and strain, or filter through linen cloth or filter paper, and bottle for table use.

Chili Vinegar.—Chop fine 25 chili peppers and pour over them ½ pint or more of pure vinegar. Let stand about ten days or two weeks, strain through cheese cloth and preserve in small bottles tightly corked for table use.

Cayenne Vinegar.—Place ½ ounce of Cayenne pepper or paprika in a glass bottle and pour over it a pint of pure vinegar. Let stand a month or more, shaking frequently. Strain into small bottles and cork tightly.

Shallot Vinegar.—Chop fine ½ dozen shallots, put them in a glass bottle, pour over them a pint of pure vinegar. Cork tightly. Let stand a month or more, strain and preserve in small bottles tightly corked.

Camp Vinegar.—Chop together ½ dozen anchovies, 1 shallot, 1 clove of garlic, and stir in ½ saltspoonful of Cayenne and 2 ounces of walnut catsup. Place in a glass bottle and pour over it ½ pint pure vinegar. Let stand a week or ten days, strain and bottle for use.



Garlic Vinegar.—Place in a glass bottle 1 ounce of finely chopped garlic, pour over it a pint of strong vinegar. Let stand ten days, shaking frequently, strain and bottle for use.

Curry Vinegar.—Place 3 ounces of curry powder in a glass bottle, add 3 pints of strong vinegar. Let stand a week or ten days in a warm place, strain and bottle for use.

PICKLES AND PICKLING

Pickling Vegetables. — Almost every sort of esculent may be preserved for table use by means of spiced vinegar. The objects to be obtained are to secure firmness or hardness of texture, to impart a fine bright green or other color, to kill all germs of decay that may be present, and to protect from the air.

Firmness of texture is secured by steeping the vegetable in strong brine for a number of days, and by picking them over at intervals to discard all doubtful specimens. This may be done by lifting them from the brine, rinsing them and after they have been picked over, covering them with brine that is freshly made. The excess of brine may then be removed by freshening them in pure salt water for twenty-four hours or more.

A fine green is imparted by lining a kettle with fresh vine leaves and packing the pickles with these in alternate layers. The addition of powdered alum sprinkled among the layers assists in setting or fixing the color. They are then covered with cold water and boiled for two hours or more until the color is satisfactory. Cooking, of course, softens them, but their freshness may be restored by dropping them into iced water for an hour or two.

Finally, scalding hot pickling liquid is poured over them both to kill the germs of decay and exclude the air. And this process may be repeated by pouring off the pickling liquid, bringing it to a boil and again pouring it over them at intervals of every two or three days for a fortnight. The jars may then be sealed, or a layer of cotton batting tied over them to exclude the germs that float in the air, and thus they may be preserved for years.

To Select Cucumbers for Pickling. —Plant for pickles a variety of cucumbers that bears a large number of small cucumbers, only 2 or 3 inches long when ripe. These are small, compact, and make firm, crisp pickles that are preferred by most persons to the large cucumber pickles, which, when ripe, are 5 to 7 inches long, 2 to 3 inches thick, and full of seeds.

Or use the small, unripe specimens of the large varieties. Cut the cucumbers from the vines carefully.

Leave part of the stem on. And take care to handle them gently. If bruised they will become soft and decay. Pick the vines clean each morning of all that are of a suitable size. This keeps the vines bearing. Pick them over carefully. Throw out any that are bruised or spotted in any way. And, if an A1 quality of pickles is desired, either for home use or for sale, sort them into lots of uniform size and shape.

To Preserve Cucumbers for Pickles. —Have ready two or more stout wooden tubs or earthenware jars, and in these each morning as fast as they are gathered pack the pickles in layers. First put on the bottom of the vessel a layer of salt ½ inch thick, then a layer of cucumbers. Over them put a layer of salt about ¼ inch thick. When about 30 cucumbers have been packed in this way, add a large cupful of water. This will dissolve the salt and make brine enough to cover the cucumbers. Put a stout board, with a stone on top, over the cucumbers to press them down in the brine. Continue to add more cucumbers from time to time as they are ready, picking them if possible in the morning before the dew is off. Add salt and water until the keg is full.

Weigh down the cucumbers securely under the brine and until ready to do them up store the keg in a cold cellar. Look at them now and then to be sure that they are kept under the brine, and add more brine, if necessary, to replace the water lost by evaporation. Let stand in brine ten days to two weeks, or until they become yellow. But they will not be injured if allowed to stand longer, provided the brine covers them.

Or after standing in cold brine for one week, lift them carefully from the brine with the hands, so as not to bruise them. Place the brine over the fire and bring it to a boil. Immerse the cucumbers in the brine while boiling hot.

Or some authorities recommend that the brine be poured off, heated, and again poured over the pickles each day for a week or more, or every two or three days. But the better opinion seems to be in favor of steeping or immersing them in cold brine for a longer period to draw out the rank juices that occur in all crude fruit rather than to pour scalding brine over them. Scalding is thought by many to be unnecessary, and to tend to make the pickles soft.

To Store Pickles.—Wooden tubs or casks are to be preferred for storing pickles in large quantities, or glass bottles or fruit jars for the finer qualities. There is an advantage in small bottles, crocks, or jars as only a small quantity need be opened at a time.

Porcelain, graniteware, aluminum, or new tinware are the most suitable vessels in which to heat the vinegar and the brine. Anything that has held grease will spoil pickles.

If packed in wide-mouthed glass bottles or fruit jars, seal tightly, or cork and cover the corks with melted paraffin or other bottle wax. But if the pickles are laid down in jars or kegs they should be looked over occasionally, and if any of them are soft they should be removed, the vinegar turned out, scalded, and again poured over the pickles. There must be sufficient vinegar to cover the pickles thoroughly, and it must be of at least medium strength. If the vinegar becomes weak, pour out and replace with fresh vinegar scalding hot. The addition of a little sugar when the pickles are looked over helps to keep them and improves their flavor. By the blending of the flavors of the various ingredients, pickles, if properly laid down, should improve with age.

Store pickles in a cold place, as if they are kept too warm they may be attacked by the small fly so familiar in autumn.

Or to lay down pickles permanently in brine, cover them with boiling water and let stand until they are cold. Drain thoroughly. Put a layer of dry salt in the bottom of the barrel, put down a layer of pickles, cover with dry salt, and so continue. Add no water. Put a weight above them and their juice will furnish the necessary moisture to dissolve the salt and make sufficient brine to cover them. A small quantity can be freshened from time to time and freshly pickled as required for use. But this method of laying down pickles is not the one commonly preferred.

To Freshen Cucumbers. — After cucumbers have been steeped in brine until they are entirely yellow, and about three days before they are to be done up, lift them carefully from the brine into a clean vessel, cover them with clean cold water and let stand three or four days, changing the water each day or oftener to freshen them.

To Pickle Cucumbers.—Pack the freshened cucumbers in wide-mouthed bottles or jars and pour over them either pure vinegar boiling hot or any desired pickle of spiced vinegar and seal.

Or first pour over them pure vinegar scalding hot and let stand in a warm place until they become green. Every two or three days pour off the vinegar, reheat it and again pour it over the cucumbers scalding hot; when the color is satisfactory pour off the pure vinegar and cover them with the spiced pickle if desired. But while the above is recommended as a thorough method designed to prepare a high-grade quality of pickles, recommendations of authorities differ very widely and good practice doubtless varies equally as much or more. One authority recommends merely washing cucumbers in salt and water, and immediately bottling and covering them with boiling hot pickle. Another, scalding fresh-picked cucumbers with boiling brine, and when cold draining and at once covering them with boiling vinegar. Another would cover fresh-picked cucumbers at once with boiling vinegar containing a handful of salt, reheating the vinegar every two or three days until they become green, then pickling and sealing. Hence it may be inferred that preserving in brine before pickling is not necesssary, but we prefer to recommend it for reasons already stated.

Authorities also differ as to whether the brine should be cold or heated, and the length of time the cucumbers should be immersed in brine, and also as to whether it is sufficient to cover the cucumbers with scalding vinegar and immediately seal, or preferable to let them stand, reheating the vinegar occasionally to green them. All of these questions must be decided by each person for himself according to the grade of pickles desired, and his willingness to take the necessary pains. In general, it is believed that the slower and more painstaking the process, the better will be the quality of the product.

Utensils for Pickling.—It was formerly customary to make pickles in kettles of brass or bell metal in order to give them a bright green color, and also to add more or less alum for the same purpose. But the action of the acetic acid contained in vinegar upon brass and similar metals is to produce a poisonous compound, especially if the pickles are allowed to stand in them until they become cold. The use of alum is also injurious, and for the same reason cheap earthenware, which is frequently glazed with lead, should not be employed.

Many people have a prejudice against deep green pickles found on the market, on account of the fear that poisonous substances may have been used in the manufacture. Hence homemade pickles of a good color and flavor usually find a ready and profitable local market.

To Test Pickles for Copper.—To find out if pickles are poisonous from having been cooked in brass or copper kettles, chop a sample of the pickle fine, place it in a glass bottle with a few drams of liquid ammonia diluted with about half as much water. Shake thoroughly, and if there are any traces of copper in the pickles the contents will be of a deep blue color.

Vinegar for Pickles.—White-wine

or sugar vinegar is perhaps the most suitable for a fine grade of pickles. But any good quality of vinegar that is fully ripened and has been previously clarified may be used. The vinegar should be boiled and freed from mother or sediment that would cause the pickles to ferment.

To Clarify Vinegar.—Throw an ounce or so of shredded isinglass into each gallon of vinegar and let stand a few days to clear. Strain through cheese cloth.

To Keep Vinegar Free from Mold.—Lay a small bag of thin muslin containing mustard on top of the pickles. If the vinegar has been properly boiled and clarified, it will tend to prevent the formation of mold.

To Strengthen Weak Vinegar.—Pour it off the pickles, bring it to a boil, pour it back over them and add about ¼ teaspoonful of alum and spread over the top layer a piece of brown paper soaked in New Orleans molasses.

Or boil down the vinegar with very gentle heat so as to allow it to lose its surplus water by evaporation.

Or allow it to freeze, and remove the ice before it melts. Acetic acid does not readily freeze. Hence the quantity of acid in proportion to the bulk of water becomes greater.

Spiced Pickle.—The following recipes are recommended for pickling liquids for cucumbers and other vegetables, mixed pickles, etc., including mushrooms, onions, walnuts, cucumbers, cauliflowers, samphires, green gooseberries, barberries, radish pods, melons, French beans, tomatoes, lemons, peaches, garlic, peas, codlins, beet root, and red cabbage without brine and with cold vinegar. The smaller and more delicate vegetables should not be soaked in brine as long as the larger and the coarser sorts, and may in some cases be pickled cold by pouring over them strong pickling vinegar without scalding. Spices for pickles should not be ground, and should be slightly bruised or crushed in a mortar, which may be improvised by using a wooden bowl and a potato masher as a pestle, or the end of a hard piece of wood. When ground spices are used they should be tied up in bags of thin muslin. To make spiced pickle add to 1 gallon of vinegar 1 cup of salt, 1 cup of sugar, 1 handful of horse-radish, 2 tablespoonfuls of mustard, 1 green pepper.

Or to every 2 quarts of vinegar add ½ ounce of mace, 1 ounce of ginger sliced, 1 dozen cloves, 1 ounce of black pepper, 1 handful of salt. Boil all together for not more than five minutes, and pour over the pickles scalding hot.

Or add to the above if desired 3 or 4 cloves of garlic and shallots.

Or to 3 quarts of pure white-wine or other strong vinegar add 2 ounces of ginger, ½ ounce of mace, ½ pound of salt, ½ tablespoonful of Cayenne pepper, 1 ounce of white or black pepper unground, 1 ounce of mustard seed, 4 ounces of shallots. Boil together not more than five minutes and pour over cucumbers and other hard, firm vegetables scalding hot, or over small and delicate vegetables cold.

Or crush together in a mortar 4 ounces of unground black pepper, 2 ounces of ginger root, 1 ounce of allspice and 4 ounces of salt. Cayenne, paprika, or garlic may be added in small quantities if desired. Place a quart of vinegar in an enameled saucepan, and bring to a boil. Stir in these spices. Let boil not more than five minutes and pour over the pickles scalding hot for cucumbers, walnuts, and the like, or cold for cabbage or fancy mixed pickles.

Or place these spices in a glass bottle or stone jar, cover with a quart of green vinegar, seal and let stand in a warm place three or four days, shaking frequently. Pour over the pickles either hot or cold.

Or to 1 gallon of vinegar add 6 ounces of salt, 1 ounce of spice, 1 ounce of mustard, ½ ounce of mace, ½ ounce of cloves, ½ ounce of nutmeg, 2 ounces of sliced horse-radish. Bruise these spices in water, mix, cover with cold water and boil not over five minutes. Pour over the pickles hot or cold, and if desired, after letting them stand twenty-four hours, place the whole in a porcelain saucepan and simmer until the color is satisfactory. Bottle and seal.

Or to every 2 quarts of vinegar add 1 teaspoonful of black pepper, 1 teaspoonful of mace, ½ cupful of sugar. Let the mixture boil up not to exceed five minutes. They may be bottled hot or cold and will be at once ready for use.

Or heat the vinegar and pour it boiling hot over the pickles.

Or place in a porcelain kettle 100 small cucumbers previously soaked in brine and freshened, cover with vinegar, add a handful of pepper corns, a handful of horse-radish, 1 ounce of cloves, 1 ounce of white mustard seed, a small quantity of Cayenne or paprika, and let the whole boil not to exceed five minutes.

Or heat the vinegar and spice and pour it hot over the pickles. The addition of horse-radish helps to keep the pickles sweet and sound. Old-time housewives used often to add to the pickles a little dill from the herb bed.

Or to each gallon of vinegar add 1 pound of good quality brown sugar, 1 tablespoonful of olive oil, 1 tablespoonful of mustard seed, 1 tablespoonful of green pepper pods, 2 ounces of horse-radish, ½ ounce of cloves, ½ ounce of mace, 1 ounce of ginger, 1 ounce of allspice.

To Pickle Large Cucumbers.—Pare 7 pounds of large cucumbers, remove the seeds and cut into inch pieces. Cover with vinegar and water, half and half, and add a large pinch of salt. Boil until clear but not overdone. Drain in a colander.

To one pint of good vinegar add 3½ pounds of brown sugar; as soon as it comes to the boiling point put the cucumbers back into the kettle and let the whole boil up. Again drain through the colander, and when cold put them in layers in a jar, sprinkle between the layers stick cinnamon, cloves, allspice, a few kernels of black pepper, a little mace, and a handful of raisins. Cover with the pickling liquid and seal.

Or cut a piece from the large end of each cucumber, leaving it attached by a piece of the skin. Scoop out the seeds and steep in strong brine for a week until entirely yellow. Stuff with equal parts mustard seed, ground ginger, and pepper, with the addition of small onions, shallots, or garlic if desired. Sew on the tops and cover with pickling liquid as for gherkins.

To Pickle Melons and Mangoes.—Prepare as for large cucumbers, cutting off the top and stuffing the inside with the same mixture. Or pickle as for gherkins. First steep in strong brine for a week or more, then freshen in clear water and pickle

in pure vinegar or spiced pickling liquid, as preferred.

Sweet Pickles — Cucumbers and Melons.—Prepare as for gherkins by steeping in strong brine for a week or more. Quarter them, take out the seed and pulp, freshen in clear water for three or four days, and cover with a sirup prepared of sugar, ginger, and lemon as follows:

Dip 1 pound of loaf sugar lump by lump in clear, soft water and place dripping wet in a porcelain saucepan. Stir in ½ ounce of bruised ginger and boil to the thread, stirring in the juice and grated rind of one lemon. Pour over the melons cold.

To Green Pickles.—If fresh grapevine leaves are obtainable, line a kettle with these and pack into it the cucumbers, etc., in alternate layers with vine leaves, and put a thick layer of vine leaves on top. In addition, sprinkle powdered alum, if desired, among the layers and over the top. Fill up the kettle with cold water and cook or steam the contents over a slow fire for two hours, or until the color is satisfactory. Drain off the hot water through a colander, immerse the vegetables immediately in iced water, and let stand for an hour or more to harden. Then pack in a suitable vessel and pour scalding hot pickling liquid over them.

Or the vine leaves may be used without the alum and will assist in giving a fine green color to the pickles.

MIXED PICKLES

To make cheap mixed pickles have at hand a keg containing vinegar and put into it from time to time odds and ends of vegetables, as small green beans, young cucumbers, small onions, radish pods, bits of cauliflower, and the like, adding vinegar from time to time to keep the vegetables covered. Thus any odd vegetables can be preserved without expense except for the vinegar, spice, etc., and with very little trouble. When the keg is nearly full place the contents in a suitable kettle with vine leaves and boil them about two hours.

Drain off the hot vinegar, immerse the vegetables in cold water for an hour or more to harden, add spices to the vinegar, boil for five minutes, drain the vegetables thoroughly, place them in a suitable keg or jar and pour the scalding hot pickling liquid over them.

Or take any assortment of succulent vegetables, as small French beans of uniform size, small select gherkins 2 or 3 inches long, small cucumbers sliced, and prepare them as for ordinary cucumber pickles.

Prepare separately such vegetables as broccoli, cauliflower stripped into branches, small pickling onions peeled, small red peppers, capsicums, radish pods, small fruit, white and red cabbage, celery, nasturtium seeds and the like by steeping for a short time, say two or three days, in brine and slightly freshening them. Now pack the gherkins and sliced cucumbers with the other vegetables in wide-mouthed glass bottles or jars in such a way as to show the greatest variety of color and display the contents to the best advantage. Much of the attractiveness and consequent salability of mixed pickles is due to skillful packing. Cover with any of the above spiced liquids recommended for cucumber pickles.

Or prepare a special pickle containing turmeric, which will improve the color. For each gallon of vinegar mix 4 ounces of ginger, 4 ounces of turmeric, 2 ounces of white pepper, 2 ounces of chili pepper, 2 ounces of allspice, 1 ounce of garlic, ½ ounce of shallots, ½ pound of bay salt. Bruise together in a mortar and boil in the vinegar not to exceed five minutes. Pour this liquid scalding hot over the vegetables and when cold slice in ¼ pound of horse-radish and stir in 1 pound of mustard seed.

Or for each gallon of vinegar mix 3 ounces of bay salt, ½ pound of mustard, 2 ounces of turmeric, 3 ounces of ginger, 1 ounce of cloves, ½ ounce of black pepper, Cayenne, or paprika to taste. Bruise the spices in a mortar, mix all together and boil in the vinegar not more than five minutes.

Mustard Pickles.—Steep in a weak brine for twenty-four hours about 2 quarts of gherkins, 1 quart of pickling onions, 2 quarts of small green tomatoes, 1 small cabbage head chopped fine, or one large cauliflower pulled into branches with 3 or 4 green peppers and boil. Then stir together in a mixing bowl 1 cup of flour, 6 tablespoonfuls of mustard, 1 heaping teaspoonful of turmeric, 1 quart of sugar. Rub up with a little cold vinegar and stir in the additional vinegar to make 2 quarts in all. Cook over a brisk fire, stirring constantly until it thickens. Pour over the pickles scalding hot and seal.

Cut into small pieces 1 quart of large green cucumbers, 1 quart of very small gherkins, 2 inches in length or less, 1 quart of white button onions, 1 quart of green tomatoes sliced and cut in cubes, 1 large cauliflower pulled into tiny flowerets, and 4 peppers sliced and cut into cubes. Do not chop the ingredients, but cut into cubes or chunks ¼ to ½ inch in thickness. Soak for twenty-four hours in a weak brine of about 1 cupful of salt in a gallon of water.

Place the whole on the fire, bring to a boil and pour into a colander to drain. Mix together in a bowl 6 tablespoonfuls of ground mustard, 1 of turmeric, 1 cupful of flour, 1 cupful of brown sugar, mix dry, rub into a smooth cream with a little vinegar, and dilute with additional vinegar, 2 quarts being used in all. Pour the mixture into a preserving kettle and let it boil until it thickens, then stir in the pickles, let them boil up. Pour into suitable cans or jars, and seal.

Or for sweet chowchow, cut into inch cubes 2 dozen small cucumbers, 6 green peppers, or 3 green and 3 red peppers, and 2 quarts of green tomatoes. Add 2 quarts of small button onions, 2 heads of cauliflower picked into pieces. Place these in a preserving kettle, and pour over them a sauce composed as follows:

Mix together in a bowl 4 teaspoonfuls of celery seed, 1 cupful of mustard, ½ ounce of turmeric, 4 cupfuls of sugar. Rub to a smooth paste with a little of the vinegar and dilute with the remainder of the vinegar, using 2 quarts in all. Pour over the strained pickles, bring them to a boil, pour out and seal.

India Pickle. — Chop together 1 peck of green tomatoes, 1 small head of cabbage, 6 or 8 large green peppers and 8 large onions. Mix and cover with vinegar and boil until they are tender. Salt to taste. Drain in a colander. Add a dressing composed of ½ pound of mustard with 2 tablespoonfuls of curry powder stirred to the consistency of cream with vinegar. Mix well and seal in glass jars or wide-mouthed bottles.

Spanish Peppers.—Steep in brine for three days ½ dozen good-sized cu-

cumbers. On the second day slice ½ dozen onions and chop fine ½ peck of green tomatoes and 2 heads of cabbage. Sprinkle these with salt and let stand overnight. Now drain the cucumbers from the brine, cut in slices, place all in a preserving kettle and cover with vinegar. Add 2 ounces of white mustard seed, ½ ounce of celery seed, 1 heaping tablespoonful of turmeric, ½ cup of mustard, 1 pound of brown sugar. Mix and simmer with gentle heat for half an hour. Pour into wide-mouthed glass bottles or jars, seal, and keep in a cool place.

Piccalilli, or Indian Pickle.—This consists of a great variety of succulent vegetables (the more varied the better) mixed and pickled together. To make piccalilli slice 1 hard white cabbage head, remove the outer leaves, pull to pieces 2 cauliflowers, add 20 selected French beans, 1 root of horse-radish, sliced fine, 2 dozen pickling onions, 1 dozen green gherkins of uniform size. Let stand in brine three or four days, drain through a colander, and place in a preserving kettle. Add 2 ounces of curry powder, 1 ounce of garlic, 1 ounce of ginger, 1 ounce of white mustard seed, ½ ounce of capsicum or paprika. Cover with vinegar and bring to a boil. Preserve in glasses tightly sealed.

Or pull apart the branches of a large head of cauliflower, cut a hard white cabbage head in quarters, remove the outer leaves, chop it fine or shred it as for cold slaw. Slice a number of cucumbers and pickling onions, French beans, radish pods, nasturtiums, samphire, and any other vegetables at hand. Place these in a large sieve, sprinkle them with salt and lay them out in the sun for three or four days to dry. Now place them in a preserving kettle, cover with cold vinegar, and bring to a boil. Let them boil up once. Pack in glass and seal.

Or if it is desired to make an extra quality, keep all the ingredients separate and scald them separately in hot vinegar, but do not put them together until they are cold. Bruise together in a mortar 4 ounces of ginger, 2 ounces of whole white pepper, 2 ounces of allspice, ½ ounce of chilis, 4 ounces of turmeric. Add ½ pound of shallots, 1 ounce of garlic, ½ pound of bay salt. Cover with 1 gallon of vinegar and boil thirty minutes. Strain through cheese cloth and add 1 pound of mustard rubbed up free from lumps with a small quantity of cold vinegar. Then dilute with more vinegar to the consistency of milk and stir into the pickling liquid. When the pickling liquid is cold pour it over the pickles. Mix well and pack in glass bottles or a large jar corked or sealed to exclude the air.

Piccalilli if well prepared should improve with age.

Chowchow.—Chowchow is the Chinese name for a kind of mixed pickles originally imported from that country and similar to piccalilli or Indian pickle, except that the ingredients are minced fine and mixed together. Chowchow is frequently used to stuff pickled peppers. It is sometimes known as English chowchow on account of its popularity in that country. French chowchow is a name sometimes applied to mustard pickles.

To make Chinese or "English" chowchow chop fine 2 medium-sized heads of firm, white cabbage, ½ peck of green tomatoes, 2 quarts of firm ripe tomatoes, ½ dozen of green peppers, and 2 red peppers. Mix all together and pack in a bag of coarse burlap or linen in layers of 2 or 3 inches deep, mixed between with layers of salt. Improvise a rack of slats of wood laid over the top of the barrel or keg into which it can drain. Place the chowchow on this and put over it a heavy weight. Let stand twenty-four hours under this pressure. Remove, pour out into a large pan and add 1½ pints of sugar, ½ cupful of grated horse-radish, ½ teaspoonful of ground mustard, 1 ounce of white mustard seed, 1 ounce of celery seed, 1 tablespoonful of mace, 1 gill of Dutch mustard. Stir well, pack in glass or wood and seal.

Or for another sort of chowchow slice or chop fine, as preferred, ½ peck of tomatoes, 1 quart of green peppers, 2 quarts of onions, 1 medium-sized cabbage head shredded as for cold slaw, and 1 quart of white mustard seed. Keep these ingredients separate and pack in layers in a jar or tub, first tomatoes, next peppers, next onions, next cabbage. Sprinkle over this part of the mustard seed, and so continue, repeating the layers again and again until all has been packed. Pour over this any strong liquid desired, scalding hot. Let stand twenty-four hours, pour the whole into the preserving kettle, bring to a boil and let boil not more than five minutes. Pack down in suitable jars or tubs and seal.

Bengal Chutney. — To make this celebrated Indian condiment, mix together 1 pound of tamarind pulp, 1 pound of sultana raisins, 1 pound of ripe tomato pulp, 1 pound of sweet apples minced fine; extract and add the juice of 12 lemons, grate and stir in the rinds; add 4 ounces of garlic, 6 onions chopped fine, ½ pound of red chilis, 12 ounces of powdered ginger, 1 pound of brown sugar. Place all together in a tub or jar, cover with a gallon of strong vinegar, and let stand for a month or more in a warm place, stirring occasionally until it is well fermented. Pack in small, wide-mouthed glass bottles and seal tightly.

Cucumber and Onion Pickles.—Cut into thick slices 3 large onions to each dozen cucumbers. Place in a colander or sieve, sprinkle with salt and let stand twenty-four hours. Place in a suitable keg or jar, cover with boiling vinegar. Cover tightly and let stand overnight. Boil up the vinegar each day, pour over them scalding hot, and at once cover tightly to exclude the air. When the color is satisfactory pour over them spiced pickling liquid and seal.

PICKLED VEGETABLES, NUTS, AND FRUITS

To Pickle Tomatoes.—Slice ½ peck green tomatoes, bring to a boil ½ gallon of any good spiced pickling liquid, and put the tomatoes to boil in this for a quarter of an hour. When cold pack away in tubs or jars and seal.

Or slice 1 peck of green tomatoes; sprinkle with salt. Let stand two days. Slice and salt separately 12 medium-sized onions. Mix in a bowl 4 ounces of mustard, ½ ounce of mustard seed, 1 ounce of cloves, 2 ounces of turmeric, and add garlic, capsicum, or paprika to flavor if desired. Put in a preserving kettle a layer of onions, sprinkle with mixed spice, then a layer of tomatoes and spice, and so on. When all are packed pour over them boiling vinegar and simmer for about two hours until the color is satisfactory.

Or slice green pickles and place

them in a colander. Steam in a kettle of boiling water until they are soft, place in jars, cover with any good pickling liquid cold. Let stand twenty-four hours, draw off the liquor, bring it to a boil and pour over the pickles scalding hot.

Or gather the tomatoes when they are turning red, but before they are dead ripe. Pack them in jars whole and without peeling, sprinkle mixed spices with a little bay salt at the rate of about a cupful to a gallon. Pour over them cold cider vinegar and seal.

Or pour over 1 bushel of whole tomatoes a quantity of boiling water. Let stand until cold, pour off the water, skin the tomatoes, place them in a preserving kettle and boil until they are soft. Stir in mixed spices. Lay down the tomatoes in jars and seal to exclude the air.

Pickled Onions.—To prepare onions for pickling, "top and tail" them, remove the outer skins and steep them in brine for a period of two or three days, to two weeks or more. Afterwards freshen them in clear water for a period of one to three days.

Or if preferred, boil them in clear water or brine for ten or fifteen minutes. Afterwards pack them in wide-mouthed glass bottles or jars, and cover with pure vinegar or spiced pickling liquid scalding hot or cold. When cold seal for use. The addition of a spoonful of olive oil to each bottle is said to keep the onions white. Cork tightly and cover the corks with bottle wax or melted paraffin. Seal with cotton batting.

To Select Pickling Onions.—Choose for pickling small silver-skin button onions, preferably of uniform size. Gather them when they are quite dry and ripe and pick them over carefully, rejecting any that are soft, unripe, or spotted.

To Pickle Onions Cold.—Place the onions in a clean, dry glass bottle or jar, cover them with cold vinegar and add mixed spices as preferred. Add a little mustard seed, mace, and capsicum, or allspice and black pepper unground or grated, or sliced horseradish or garlic, capsicum and paprika, if desired. Seal the bottle and let stand two or three weeks before using. Onions are very easily pickled in this way and have an exquisite flavor, but will not keep more than about six or eight months.

To Pickle Onions with Brine.—Cover the onions with cold brine and let stand two weeks or more, or steep in strong brine for one week, then heat the brine and pour it over them scalding hot.

Or pour over them at once strong and hot brine and let stand two or three days. After steeping in brine drain through a colander, freshen in clear water for twenty-four hours, pour off the water and lay them on a dry cloth to drain. Pack them in jars or bottles and cover with spiced pickling liquid boiling hot. Cork tightly and seal.

Or pour over them cold pickling liquid or cold vinegar and seal.

Pickled Cabbage.—Select firm, ripe heads of either white or red cabbage, or mix the two. Quarter them, remove the outside leaves, and let them dry. Shred them as for cold slaw and lay them down in a suitable jar between layers of salt. Cover with strong spiced pickling liquid and seal.

Or shred the cabbage, place it in a preserving kettle or suitable jars, and cover with boiling water. Let stand until cold. Drain. Add mixed spices and cover with cold vinegar, or cover with spiced pickling liquid.

Or boil the cabbage in salted water until it is tender. The pickling liquid may be poured on cold or scalding hot. In the latter case let stand until perfectly cold. Seal air tight and store in a cool, dry place.

Or if the jars are not air tight, after a few days open them, fill up with vinegar and again seal.

Pickled Cauliflower.—Cut the cauliflowers on a dry, hot day, after the dew has evaporated and before they are fully blown. Slice and sprinkle them with salt, and let stand for two or three days.

Or boil in salt and water until they are tender. Drain off the water or juices, spread upon a dry cloth, covering with another cloth, and let stand in a warm place for twenty-four hours. Pack in jars, cover with cold spiced pickling liquid and seal.

Or place the cauliflowers in cold salt and water at the rate of 4 ounces of salt to 1 quart of water, and bring to a boil over a slow fire. Remove immediately and cover with cold spiced vinegar.

Pickled Green Corn.—Pull the ears of corn when slightly overripe but not too hard. Take off the outer husks, leaving the corn well covered with the inner husks, and tie the latter tightly at the top end. Pack the ears of corn thus prepared in a clean firkin or cask and cover with strong brine. When wanted for use soak in fresh water twelve hours or more, changing the water occasionally.

Pickled Walnuts.—Pick small green walnuts about the first week in July or before the middle of the month, after which they are likely to become hard and woody. Test them by thrusting a strong pin through them, and discard all that are too old and hard. Scald them slightly in boiling water. Rub off the outer skin between cloths (or this may be omitted if preferred), and put them into cold brine strong enough to bear up an egg. Thrusting a pin through them also allows the pickle to penetrate more thoroughly and quickly than would otherwise be the case. Let them stand a week or two, changing the brine every two or three days. Pour them out in a sieve or into a cloth strainer to dry and let them stand a day or two or until they turn black. Pack them in bottles or jars and pour over them spiced pickling liquid scalding hot. Let stand until cold and seal.

Or if they are not to be sealed air tight, pour off the pickle each day for three or four days, bring it to a boil, take off the scum and pour over the walnuts scalding hot.

Or instead of steeping in cold brine, place the walnuts in a strong brine and simmer for an hour or two. Expose in a sieve or cloth strainer twenty-four hours or more, or until they turn black. Pack and cover with scalding hot spiced pickling liquid. Two to six months will be required before they are fit to eat. During this time they must be kept covered from the air either by sealing the jars or keeping them covered with vinegar.

To Pickle White Walnuts.—Pick small green walnuts as above and pare them very thin, or until the whites appear. Place in cold brine strong enough to bear up an egg and simmer for five or ten minutes, but do not let them come to a boil. Drain

and cover them with cold brine for twenty-four hours or more. Pour out in a sieve or cloth strainer, cover them with a cloth, dry them carefully between clean, soft pieces of cloth and pack them down with blades of mace, nutmeg, and horse-radish. Cover with cold or hot vinegar and when cold seal tightly to exclude the air.

Pickled Lemons. — Slice ½ dozen lemons, sprinkle them with salt, lay them down in a large glass jar and sprinkle among them 2 ounces of spice, 2 ounces of white pepper, ¼ ounce of mace, ¼ ounce of cloves, all bruised together in a mortar with ¼ ounce of Cayenne, 2 ounces of horse-radish, 2 ounces of mustard seed. Pour over them 2 quarts of vinegar scalding hot. This pickle is for immediate use, and will be ready in three days to a week. Red peppers, paprika, or garlic and shallots may be added if desired.

Or cut ½ dozen lemons into six or eight pieces, cover with the mixed spices, as in the first recipe, place in a preserving kettle, cover with 2 quarts of vinegar and boil a quarter of an hour.

Or pack the lemons in a jar, set the jar in boiling water and boil for fifteen or twenty minutes. Let the jar stand in a warm place stirring daily for several weeks. Finally, bring to a boil, pack in small jars or bottles and seal.

"Pickles and Pickling."

Or to pickle whole lemons, select small fruit and slit the rinds as if to take off the peel in quarters, but do not cut through the pulp. Cover the lemons with salt, and pack it down hard to fill these slits. Pack them on end in a dripping pan three or four days, or until the salt melts, and let them stand, turning them end for end in the liquor two or three times a day until the rinds are tender. To this liquor add sufficient spiced vinegar to cover the lemons. Pack them in jars with mustard seed and garlic. Cover with any prepared pickling liquid and seal.

Or pare a dozen lemons very thin, taking off so little of the outer portion of the rind that the white will not be seen. Cut a gash in each end and rub them thoroughly with salt, rubbing it into the gashes. Cover with salt and let stand for three or four days. As the salt dissolves rub more into them and especially fill the gashes at the end. Now cover with dry salt, place them in a very slow oven with a dozen cloves of garlic and half a teacupful of scraped horse-radish, and let them dry, taking care that they are not burned, or even browned. They should be thoroughly dried out—as dry as paper. Now pour over them a gallon of spiced pickling liquid cold. Place the whole in a suitable jar, and let stand in a warm place for two or three weeks, stirring or shaking frequently. Shake well and strain off a little of the liquid from time to time for table use in soups and sauces. Shred the lemons fine when required for made dishes, soups, sauces, etc.

Pickled Peaches. — Look over the peaches carefully, selecting the ripe fruit and discarding all that are soft or specked. Rub clean with a soft, dry cloth and stick into each large peach 4 or 5 cloves without the heads, and into each small one 2 or 3 cloves. Place in a preserving kettle 1 gallon of vinegar. Stir in 6 pounds of brown sugar and bring to a boil, removing the scum as fast as it appears. Pack the peaches in suitable bottles or jars. Pour the boiling sirup over them scalding hot and cover tightly. Let stand overnight, pour off the sirup once more, bring to a boil and again pour over the peaches. Do this for three or four days. Finally, pack in cans or bottles and seal while hot.

Or for sweet-pickled peaches, allow ½ pound of sugar by weight to each pound of fruit. Put the sugar and peaches in layers in a preserving kettle and bring to a boil. Add for each 6 pounds of fruit a pint of vinegar and in the vinegar place a thin muslin bag containing a tablespoonful each of cinnamon, cloves, and mace. Pour the spiced vinegar into the peaches and sirup with the bag of spices, and boil for not more than five minutes. Take out the peaches with a skimmer, lay them on blotters to cool and continue boiling the sirup until it thickens. Pack the peaches in jars, fill to overflowing with boiling sirup, and seal at once.

Or for sour pickled peaches, select full-grown peaches before they are ripe. Salt them in strong brine for a week or two, change the brine every two or three days, dry them on a cloth strainer, wipe them with a cloth and cover with hot, spiced, pickling liquid containing garlic, mustard, ginger, cloves, and the like. Seal and store for four or five months before bringing them to the table.

Pickled Pears.—The above recipes for pickled peaches may also be applied to pickled pears.

Or pack in a preserving kettle in alternate layers 10 pounds of ripe pears and 3 pounds of coffee sugar. Pour over them 1 quart of vinegar containing, in a thin muslin bag, 1 ounce of cinnamon, 1 ounce of cloves, ¼ ounce of mace. Slice and stir in 4 ounces of citron and boil until the pears are tender. Take out the pears with a skimmer, boil the sirup half an hour or more until it is thick. Fill the jars or cans to overflowing and seal at once.

Or prepare a sirup of 1½ pints of vinegar and 3 pounds of fine sugar. Bring this to a boil. Place in a preserving kettle a peck of ripe fruit, peeled and cored, pour the sirup over it and boil until the fruit is tender, but not soft. Remove the fruit with the skimmer and pack it in jars. Preserve the sirup, which may be used again, and prepare a fresh sirup of 1½ pints of vinegar and 2 pounds of coffee sugar. Place in this sirup a thin muslin bag containing an ounce each of any kind of mixed spices preferred. Bring to a boil, fill the jars to overflowing, and seal.

Pickled Cherries. — Fill a wide-mouthed glass bottle or jar with nice firm and medium ripe cherries. Add 2 tablespoonfuls of salt, and fill the jars with cold vinegar. Seal and let stand six or eight weeks before using.

Pickled Peppers.—Soak fresh bell peppers, either green or red, in strong brine for a week or two, changing

every two or three days. Pack in suitable jars and cover with cold vinegar. The seeds tend to make the peppers very strong, and may be removed if less strength is desired. A few peppers added to pickled cucumbers improves them very much, as the heat of the peppers is taken out by the vinegar and becomes blended with the cucumbers, giving them an agreeable flavor.

Pickled Beets. — Select small red beets having the roots on and wash them carefully so as not to break the roots or the skin. Place in a large kettle, cover with plenty of water and boil three or four hours. Take them up carefully with a skimmer so as not to break the skins. Place them on a cloth strainer to cool and dry. When cold, quarter them or pack them in suitable jars, cover with pure or pickled cold vinegar, and seal so as to exclude the air. If not sealed it will be necessary to pour off the vinegar occasionally, bring it to a boil and pour it scalding hot over the beets.

Or after the beets have been boiled, pack them in jars and cover with hot brine strong enough to float an egg. When cool put the jars in a saucepan full of cold water, place it on the stove, and boil half an hour or more. Seal air tight while hot and store in a cool place.

Nasturtiums. — Collect the seeds while young and tender. Place them in a double boiler, cover with strong cold brine. Let stand for an hour, then place on the stove and bring to a boil. When they boil up take them out of the skimmer, put them into a suitable jar, and cover them with boiling hot spiced pickling liquid.

Or have at hand a jar of sweetened spice vinegar and into this drop nasturtium seeds picked as they accumulate during the season before they become hard and woody. They make an excellent substitute for capers and an agreeable addition to salads or sandwiches.

Pickled Barberries.—To pickle barberries for a garnish, especially for cold meats, salads, and the like, select the large, firm bunches of berries of a fine deep red. Remove the leaves and the discolored berries. Place them in jars and cover with brine strong enough to float an egg. Seal to exclude the air, or cover with paraffin or waxed paper. If any scum or mold appears upon the surface pour out the barberries on a cloth strainer, dry them between two cloths, and cover them with fresh brine.

To Pickle Mushrooms. — Select small button mushrooms, remove the stems, rub off the skins with a piece of flannel moistened in salt water and throw them into weak brine of about a cupful of salt to a gallon of water. Let stand three or four hours. Pour them out on a cloth strainer to drain and dry.

Or after cleaning them with salt and water, put them over a slow fire until the juice from them has dissolved the salt. Then pour them out to drain on a cloth strainer. Finally, pack in suitable jars or bottles and cover with spiced pickling liquid, scalding hot, or place the mushrooms in the spiced liquid and boil for ten minutes. Pack in bottles, cover with the scalding liquid. Let stand until cold, and seal.

Pickled Melons.—Take hard muskmelons that are late in ripening, cut out a circular piece around the stem about 3 inches across and through this opening remove the seeds and scrape out any part that may be soft or ripe. Pack the melons in a wooden tub, fill them inside, and cover them with salt and let stand until the salt is melted. Remove them from the salt, rinse with pure water and fill with a mixture of chopped peppers and onions with a few shallots, a little garlic, and a quantity of bruised mustard seed. Close the opening with the plug, and fasten it with thread or with skewers made of toothpicks. Pack the melons in a tub or earthen jar and cover with spiced pickling liquid boiling hot. Remove and scald the spiced liquid every day for four or five days, pour it back over the melons, and finally seal up the jars.

Or stuff the melons with a piccalilli or chowchow or any sort of mixed pickles, as desired.

Pickled Citron. — Cut the citron into inch cubes, cover with weak brine. Let stand twenty-four hours and pour out on a cloth strainer to dry. For every gallon of spiced vinegar add 4 ounces of coffee sugar, bring to a boil and pour over the citron boiling hot. Let stand three or four days, each day pouring off the pickling liquid from the citron, scalding it and pouring it back. Finally, bring the whole to a boil and cook until the citron is very tender. Pack in suitable jars. Seal and store in a cool, dry place.

Peach Mangoes.—Select large freestone peaches and take out the stone through a slit in the side. Cover with weak brine scalding hot. Let stand until cool enough to handle. Lift out the peaches on a cloth strainer, and wipe dry with a clean, soft cloth. Now fill the cavity with mixed spices to taste, as white mustard seed, cloves, mace, cinnamon, grated horse-radish, ginger root, etc., softened by placing all together in a thin muslin bag and immersing for a few minutes in boiling water. Remove the bag from the water, let the spices drip dry, fill the peaches, sew them up, pack them in jars, and fill to overflowing with a scalding hot sirup made of 1 pint of sugar in 3 pints of vinegar. Seal while hot. Let stand a week or two before bringing to the table.

Tomato Catsup. — Wash ½ bushel fine ripe red tomatoes. Quarter them, place them in a preserving kettle, and bring them to a boil. Remove from the fire and let cool until they will bear the hands. Then rub them through a wire sieve and add to the strained juice 2 teacupfuls of salt, 2 teacupfuls of mixed spices, 1 quart of vinegar. Boil over a slow fire for an hour or more, stirring constantly to prevent burning. Fill the bottles to overflowing with the hot liquid and seal at once. Thin for use, if necessary, with a little vinegar. Wrap in colored paper to exclude the light.

Or boil the tomatoes until they are soft. Squeeze them through a fine sieve, and to the juice add 1 pint of salt, 1 ounce of Cayenne pepper, a few cloves of garlic or shallots. Mix and boil until reduced one half. Bottle and seal.

Or cut up the tomatoes, place them in a preserving kettle in layers sprinkled with salt, using about 2 teacupfuls of salt to ½ bushel of fruit. Let stand three or four hours before boiling. Strain and add to the juice horse-radish, onions, or garlic, mustard seed, and mixed spices. Let stand twenty-four hours or more. Boil down to the right consistency. Bottle and seal.

Select firm, ripe tomatoes, gash them on two or three sides and place them in a porcelain saucepan. Boil them to a pulp. Rub the pulp through a colander or coarse sieve, and afterwards through a hair or other fine sieve, and for each peck of fruit add 1 ounce of salt, 1 tablespoonful of black pepper, 1 teaspoonful of Cayenne, 1 ounce of mace, 1 ounce of ground cloves, 6 ounces of ground mustard and 1 ounce each of celery seed and mustard seed tied in a cheese-cloth bag. Boil the whole for four or five hours, stirring frequently, especially toward the last. When the catsup is of the right consistency, remove from the fire and let stand overnight to cool. For each peck of fruit stir in 1 pint of pure white wine or cider vinegar. Remove the bag of celery and mustard seed. Bottle and cork tightly. Store in a cool, dark place.

Or cut the tomatoes in half and boil to a pulp. Press through a coarse, and afterwards a fine sieve, and for each peck of fruit add seasoning as follows: ⅛ ounce of Cayenne pepper, ½ ounce of black pepper, ½ ounce each of mace, allspice, cloves, 2 ounces of mustard. Salt to taste and add ginger or essence of celery if desired. Boil as above. When cool, stir in 1 pint of vinegar for each peck of fruit. Bottle and seal as above.

Or cut the tomatoes into quarters, place them in a porcelain saucepan and boil to a pulp. Run through a coarse, and afterwards a fine sieve, and boil down for three or four hours, or until as thick as jelly, stirring constantly especially toward the last to prevent burning. Stir in for each peck of fruit, 3 ounces of salt, 3 drams of allspice, ¾ ounce of yellow mustard, 1½ ounces of black pepper, 4 drams of cloves, ½ ounce of Cayenne pepper, 2 quarts of pure white-wine or cider vinegar. Stir in the ground spices and the vinegar. Bring the whole to a boil for not more than five minutes and bottle when cold.

Canning Tomatoes. — Select firm, ripe tomatoes, place them in a colander and dip them into boiling water just long enough to loosen the skin. Remove from the water, place them where they will drain, and carefully pull off the skin without injuring the fruit. Once more place in colander to drain and pack carefully in large glass jars or cans as full as they will hold. Place these in hot water, bring to a boil and seal.

Or if tin cans are used, first apply with a soft brush fresh butter or unsalted lard to the inside of the can and its cover. This will prevent the fruit acid from attacking the tin and forming a poisonous compound. Seal with a bit of solder or putty, or lay over the top a cloth dampened with alcohol, run paraffin over this and draw over the top a piece of cotton batting.

Currant Catsup.—Pick over carefully 2 pounds of ripe red currants and place them in a preserving kettle with ¾ of a pound of granulated sugar. Cook until of the consistency of thick cream. Boil in a separate saucepan for not more than five minutes ¾ of a pint of vinegar, in which place a muslin bag containing ½ tablespoonful of ground pepper, and any other spices desired. Pour the spiced vinegar into the currants and sugar and bottle for use.

Mushroom Catsup. — There is a prejudice against mushrooms due to the existence of certain poisonous species. Those who are not thoroughly conversant with the difference between the edible and poisonous varieties should buy mushrooms from a reliable dealer or buy the spawn and grow the mushrooms rather than attempt to gather the native varieties growing wild. As there is a possibility that poisonous mushrooms may be offered for sale by careless or ignorant persons, we give the following rules for distinguishing mushrooms from poisonous toadstools. The greatest caution should, however, be used where there is the slightest doubt, as no matter how good a rule may be, there can be no assurance that it will be understood or intelligently applied by an inexperienced person.

As a rule, the false mushrooms grow in tufts or clusters in woods or on the stumps of trees. They are likely to have a cap covered with warts or fragments of membrane growing on the upper surface, and to be heavy and irregular in shape. They have a disagreeable taste, like alum, turn blue when cut, are moist on top and usually of a rose or orange color.

The true mushroom, on the other hand, has under parts or gills of a pinky red, changing to a liver color. The flesh is pure white, and the stem is long, white, and round.

The best rule is to sprinkle a little salt on the spongy parts or gills of one of the mushrooms and let it stand for some minutes. Be sure to allow plenty of time. If it turns yellow the mushrooms are poisonous. If black, they are edible.

To make mushroom catsup pack 2 pounds of mushrooms in layers with 1 pound of salt in a saucepan, and let stand until the salt is fully dissolved. Squeeze through cheese cloth and add to the juice 3 ounces of white pepper, ½ ounce of cloves, or any other mixed spices desired. Boil with gentle heat to the consistency desired. Strain and bottle for use. Add more salt to the mushrooms from which the juice has been strained, and if sufficient juice has been left in them to dissolve the salt it may be used to make an inferior quality of catsup.

Or add to each pound of mushrooms ½ pound of salt. Let them stand for four days stirring them occasionally. Pour them into a colander to drain and preserve the juice. Now add a little cold water to the mushrooms and let them boil half an hour or more over a slow fire. Squeeze them through cheese cloth. Now mix both liquors. Add any desired mixture of spices. Boil not over five minutes. Seal and bottle for use.

Or squeeze out the juice in a press and to each gallon of juice add 1 pound of salt, 1½ ounces of shallots, and any desired mixture of spices to the amount of four to six ounces all told. Boil for one hour or until of the desired consistency. Strain and bottle for use.

To preserve mushroom catsup in its full strength it is necessary to reboil it at intervals of a month or six weeks, adding fresh spices. By these means it can be kept good and fresh the year round.

To Preserve Mushrooms. — Select small mushrooms, trim them and rub them clean with a soft flannel cloth. Drop them immediately into cold water to preserve their color. Place them in a saucepan and to each quart of mushrooms add 3 ounces of butter, 2 teaspoonfuls of salt, ½ teaspoonful of Cayenne, ¼ teaspoonful of mace, and cook until tender. Pour them into a colander to drain. When cold, pack them in glass jelly tumblers or fruit jars and pour clarified

mutton suet or butter over them. Lay over this a thickness of cloth dipped in alcohol and tie over the top a layer of cotton batting.

Or trim and clean the mushrooms, peel off the skin and dry them in a slow oven. Tie up tightly in paper bags and hang up in a dry place. They will resume their natural size when cooked.

Or season mushrooms with onion, cloves, pepper, mace, or otherwise to taste. Slice, and dry in a slow oven. Rub to a powder and preserve in tightly stoppered jars or bottles.

Preserving Olives.—After opening a bottle of olives, if the remainder are not required for immediate use, pour off the liquid and cover with olive oil. This will keep the olives good and fresh for several weeks.

Walnut Catsup.—Pick young green walnuts about the first week in July, as for pickled walnuts, and squeeze the juice out of them under a press. Or run them through two or three times with a hatpin. Crush them with a wooden mallet, place in a keg or jar throwing in a handful of salt for each two dozen walnuts. Cover with water and let stand two weeks or more, stirring frequently. Squeeze out the liquor through cheese cloth into a preserving kettle. Moisten the walnuts with boiling hot vinegar and mash them to a pulpy mass. Pour on additional hot vinegar to cover them. Mix and squeeze out the vinegar into the juice and brine in a preserving kettle. Add to each gallon of juice 12 or 14 ounces of mixed spices as desired, bruising the whole spices in a mortar, or placing the ground spices in a thin muslin bag. Flavor with Cayenne, paprika, garlic, or shallots as desired, and boil one hour or more, or until reduced about one half. Bottle and seal when cold.

Or bring the walnut juice to a boil and skim until it is clear. For each quart of walnut juice add ½ pound of anchovies, ½ pound of shallots and 1 or 2 ounces of mixed spices. Flavor with garlic, Cayenne, paprika, celery, etc., as desired. Simmer over a slow fire about twenty minutes, salt to taste. Strain through cheese cloth. Bottle and seal when cold. This catsup will keep indefinitely and will not be at its best under one year after it has been made.

Or crush the green walnut shells and to each ½ peck of shells, dry measure, add 1 quart of salt. Mix and let stand a week or ten days. Squeeze out the juice. Add to each gallon of juice about 12 ounces of mixed spices, flavoring with garlic, etc., if desired, and boil down about one half. Bottle when cold.

Or take 1 gallon of spiced vinegar in which walnuts have been pickled for six months or a year. Add ½ pound of anchovies, 1 teaspoonful of Cayenne. Boil down one half and bottle when cold. Thus the spiced vinegar from the pickied walnuts may be turned into good catsup after the walnuts have been used.

Camp Catsup. — A catsup mixed with stale beer and various spices is often put up and sold under this name for sea stores or persons going on exploring and other expeditions and likely to be gone a long time. It will keep under all conditions for many years.

To 1 gallon of strong stale beer add 1 pound of anchovies washed and cleaned, 1 quart of mushrooms, first rubbing off the skins with salt and water, 1 pound of shallots, and 8 or 10 ounces of mixed spices. Boil down one half over a slow fire. Strain through cheese cloth and bottle when cold.

Or to 1 gallon of strong stale beer add 3 quarts of vinegar, 1½ pounds of cleaned and washed anchovies, 1½ pound of shallots, 8 or 10 ounces of mixed spices, and 2 quarts of mushrooms. Boil down one half and bottle when cold.

Or mix 2 quarts of stale beer to 1 quart of white wine or white-wine vinegar. Add ½ pound of anchovies, 4 ounces of peeled shallots, 4 ounces of mixed spices. Let stand in a warm place two or three weeks, stirring constantly. Bring to a boil and bottle when cold.

Oyster Catsup.—Squeeze through a sieve 1 pint of oysters with the juice. Add 1 pint of white wine or sherry, and salt to taste. Add 2 or 3 ounces of mixed spices. Flavor with garlic, celery, etc., as desired. Simmer fifteen or twenty minutes. Strain and bottle when cold.

Pepper Catsup.—Place in a preserving kettle about 25 large red bell peppers without removing the seeds. Add 1 pint of vinegar and boil until tender, stirring constantly. Rub the whole through a sieve. Set aside the juice. Pour over the pulp another pint of vinegar with 2 tablespoonfuls of brown sugar, and 2 or 3 ounces of mixed spices. Stir all together and boil down one half. Strain through cheese cloth and bottle when cold.

Gooseberry Catsup.—Select gooseberries that are ripe but not soft, pick them over carefully, and remove the stems and blossoms with a pair of small scissors. To each quart of gooseberries add 1 pound of brown sugar and 1 ounce of mixed spices. Place in a preserving kettle and boil to a soft pulp or for about 2 or 3 hours stirring constantly. Add for each quart of gooseberries ¼ pint of vinegar. Bring to a boil. Fill bottles to overflowing and seal while scalding hot.

Grape Catsup.—Take grapes that are ripe but not soft. Pick them over carefully and add ½ by weight of sugar and to 5 pound of grapes 1 pint of vinegar, 2 or 3 ounces of mixed spices, and salt to taste. Boil until it thickens. Bottle when cold.

To Preserve Horse-Radish.—Slice the horse-radish in November and December about 1/16 of an inch thick. Place it in a tin pan, cover and set it in a warm place near the stove to dry; but do not heat it too much, as otherwise it will lose its flavor. When bone dry grind it in a mortar, place it in suitable jars or bottles, and seal for use.

Or grate the green roots, cover with strong vinegar. Bottle, seal, and store in a cool place.

To Preserve Tomatoes for Soup.—Select all the small cracked or faulty-shaped ripe tomatoes that are unmarketable, wash, trim, and cut them up unpeeled in a preserving kettle. Stew them well, grind them through a flour sieve so as to remove the seeds and skins, reheat and can for soup stock.

Or take the large, sound, ripe tomatoes, wash and drain, halve them crosswise, and pack them with the cut side up between layers of salt in a jar or wooden firkin. Let stand twenty-four hours or until the salt melts. Now pour off and discard the brine and seeds that escape with it. Boil the tomatoes to a pulp, and rub through a flour sieve. Season with Cayenne pepper or paprika, salt to taste and boil to the consistency of

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cream, stirring briskly. Pour out to a depth of about $\frac{1}{2}$ inch on large platters, and let dry in the sun or a slow oven. Before it dries mark in 3-inch squares with a sharp knife and when fully dry pack tightly in hot, dry glass jars. Seal closely to exclude the air, and store in a dry place. One of these squares will season 2 or 3 quarts of soup, or enough for a large family.

Or the squares may be soaked in warm water and stewed with bread crumbs as tomato sauce.

Or peel large, ripe tomatoes, remove the seeds, pack them in a preserving can with pepper and salt. Let stand twenty-four hours or until the salt is melted, and boil for an hour or more, stirring frequently. Pour into small jars or bottles, as it will not keep well after being opened, and seal when cold.

Curry Powder. — To make curry powder mix together the required spices, which should be of the best quality, and well dried in a slow oven. Grind them to powder in a mortar. Pack in small bottles, and seal for use.

Or if preferred, the required spices may be mixed whole in the small pepper grinders which are to be had for table use, and the powder may be freshly ground as required.

To use curry powder, mix 1 tablespoonful of the powder with 1 of flour. Add 1 cupful of fresh milk. Season with salt and lemon juice, and pour into soup or stews and the like fifteen or twenty minutes before serving.

The following proportions are recommended: 4 ounces of turmeric, 4 ounces of coriander, 4 ounces of black pepper, 3 ounces of fenugreek, 2 ounces of ginger, 1 ounce of cummin seed, 1 ounce of ground rice, $\frac{1}{2}$ ounce of cardemoms, $\frac{1}{2}$ ounce of paprika.

Or 4 ounces of turmeric, 4 ounces of coriander seed, $2\frac{1}{2}$ ounces of pimento, 1 ounce of ginger, $\frac{1}{2}$ ounce of cinnamon, $\frac{1}{2}$ ounce of mace, $\frac{1}{2}$ ounce of cloves, 2 drams of cummin seed, 1 ounce of cardemom, 1 ounce of Cayenne.

Or 2 ounces of turmeric, 5 ounces of coriander, $\frac{1}{2}$ ounce of paprika, 2 ounces of pimento, $\frac{1}{4}$ ounce of cloves, 2 ounces of cinnamon, 1 ounce of ginger, $1\frac{1}{2}$ ounces of cummin, 1 ounce of shallots.

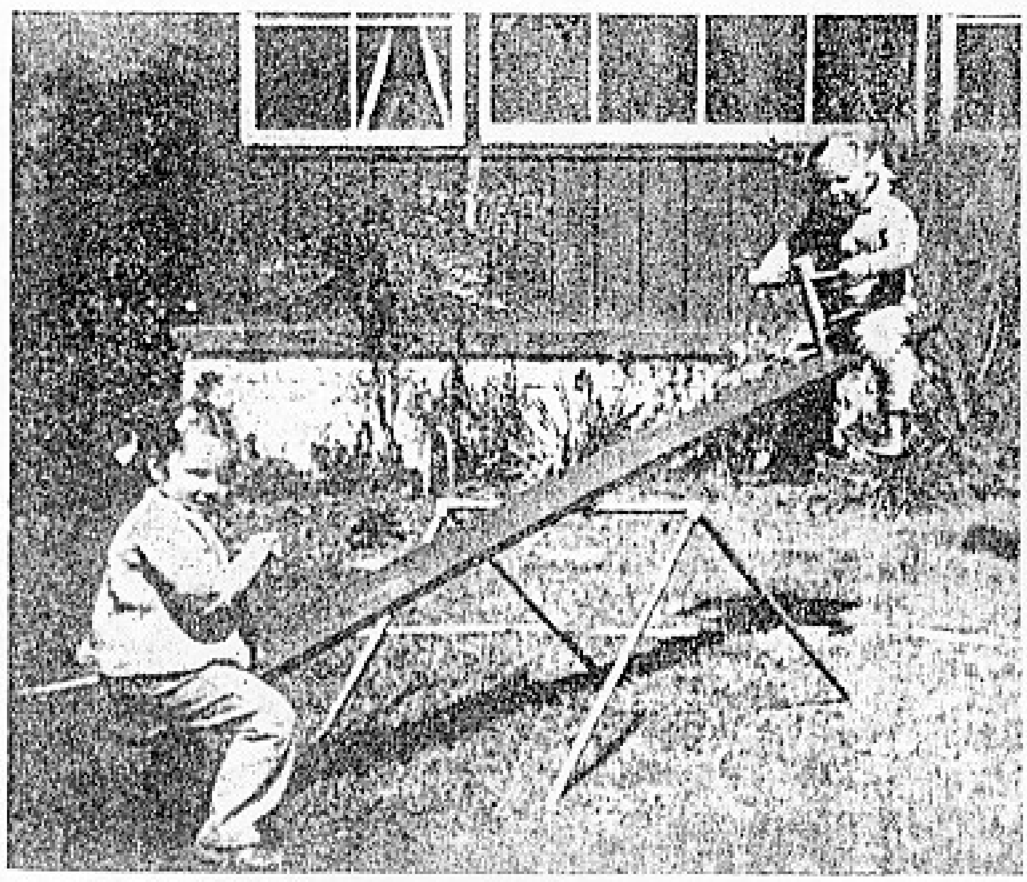
POPULAR SCIENCE JULY, 1945

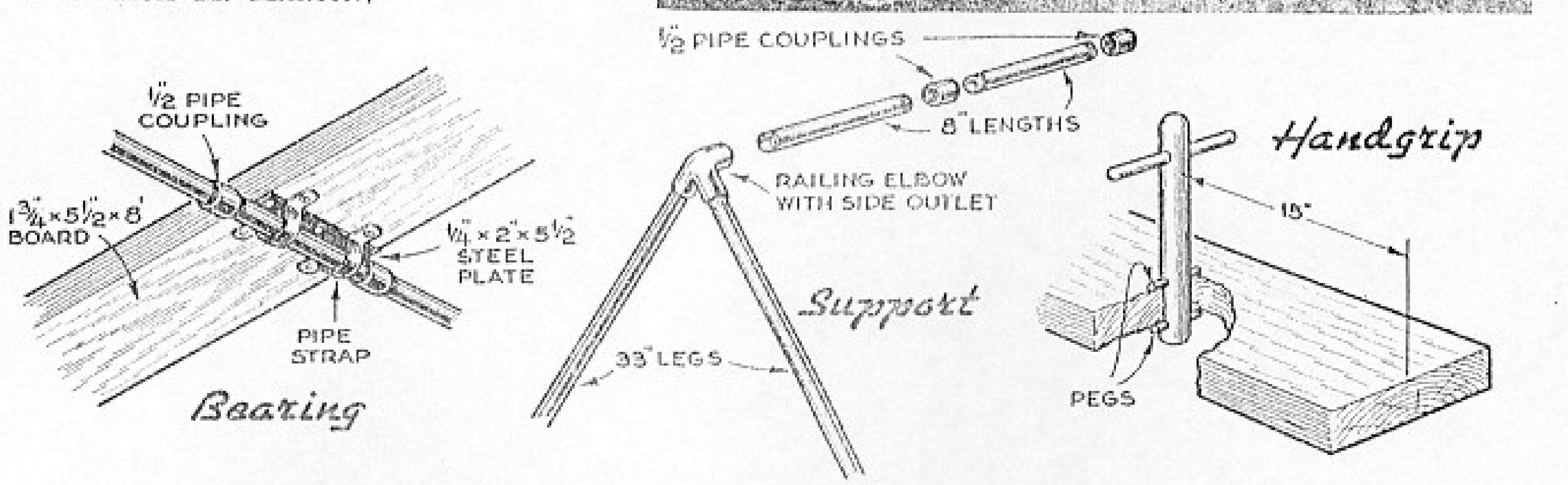
Back-Yard Seesaw with Pipe Support Is Safe for Small Children

UNWELCOME spills are next to impossible on a safety seesaw held to its fulcrum with pipe straps and fitted with upright handles to which even the littlest tots can cling while riding up and down with the board. The assembly is so light that two children can move it around to suit their fancy.

Short lengths of pipe assembled with two side-outlet elbows and two couplings that prevent side slippage form the fulcrum. The bearing is made with a steel plate and two pipe straps, as shown in the drawing. It can be attached to the teeter board either at the center, if the children are nearly the same weight, or off-center for those whose size differs greatly.

The hand-grip uprights may be large doweling or square stock rounded by plane or in the lathe and held with pegs.
—KENDRICK M. MARTIN.





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The Household of the Detroit Free Press 1881

DIM AREAS ARE DUE TO IMPERFECT ORIGINALS

CATSUPS AND SAUCES.

HOW TO COMPOUND THEM.

Select perfect fruit; always cook in porcelain, never in metal; bottle in stone and glass, and never use tin; keep in a dry, dark, cool place. If, on opening, there is mold on the catsup, remove carefully every particle of it, and the catsup will not then be injured. To prevent this molding, the cans may be filled nearly to the top with the catsup and the rest filled up with hot vinegar. If, on opening, there is danger of the rest spoiling, heat it thoroughly, and if too thick add vinegar. Some do not boil their catsup but instead sprinkle the tomatoes with salt and let them stand over night, then strain and add spices. The following will apply to cherries, peaches, plums, grapes and all kinds of berries. The object is to get the pulp of the fruit as the foundation for the catsups, and they wonderfully retain their flavor, notwithstanding all the ingredients added: To every quart of the juicy pulp allow one pound of sugar, two blades of mace, three of cinnamon, one teaspoonful of whole cloves, one of pepper corns; boil all down one third, then skim out the spices, add the sugar and boil till thick, and then reduce to a proper consistency with vinegar, and bottle for use.

For seasoning food and sauces are herbs which usually are dried during the summer season. Many people have the idea that a finely-flavored dish must cost a great deal; that is a mistake; if you have untainted meat, or sound vegetables, or even Indian meal, to begin with, you can make it delicious with proper seasoning. One reason why French cooking is much nicer than any other is that it is seasoned with a great variety of herbs and spices; these cost very little; if you would buy a five cents' worth at a time you would soon have a good assortment. The best kinds are sage, thyme, sweet marjoram, tarragon, mint, sweet basil, parsley, bay leaves, cloves, mace, celery seed and onions. If you will plant the seed of any of these seven first mentioned in little boxes on your window sill, or in a sunny spot in the yard, you can generally raise all you need. Gather and dry as follows: Parsley and tarragon should be dried in June and July, just before flowering; mint in June and July; thyme, marjoram and savory in July and August; basil and sage in August and September; all herbs should be gathered in the sunshine, and dried by artificial heat; their flavor is best preserved by keeping them in air-tight tin cans, or in tightly-corked glass bottles.

TOMATO CATSUP.

Take a bushel of ripe tomatoes; rub them with a damp cloth; cut out the hearts, and place them over a fire with two heaping handfuls of peach leaves, one dozen large onions (cut in small pieces) and one quart of water; boil until soft and strain through a coarse sieve; it will take about two hours to boil soft enough. Put the liquid in the boiler again over the fire, adding a half gallon of strong vinegar. Have ready two ounces ground allspice, two ounces ground black pepper, two ounces cayenne pepper, two ounces mustard and, if preferred, two ounces celery seed, one ounce ground cloves, two grated nutmegs, two pounds brown sugar and one pint of salt; mix the ingredients thoroughly before putting them in the boiler. Boil two hours and when cool put in bottles, cork, seal and keep in a cool place.

CHERRY CATSUP.

One pint of pure cherry juice, half a pound of sugar, a teaspoonful each of ground cloves and cinnamon. Boil to a thick syrup and bottle.

GRAPE CATSUP.

Nine pounds of grapes and six pounds of brown sugar. Boil the grapes until soft; rub through colander; add sugar and boil until quite thick, then add three pints of vinegar, one tablespoonful each of cloves, cinnamon, allspice and black pepper.

MUSHROOM CATSUP.

Take the full grown mushrooms; wipe them clean and crush them with your hands; throw in a handful of salt with every peck of mushrooms and let them stand all night; strain through a sieve and press out all the juice. To every gallon of liquor put cloves, Jamaica ginger and black pepper, one ounce of each, and half pound of salt. Set it on a slow fire and let it boil until half the liquor is wasted, then put into an earthen vessel; when cold bottle it.

CUCUMBER CATSUP.

Take green cucumbers, as you like them for the table, peel them and let them lie in salt water a short time. If large, cut in two and scrape out the seeds, grate on a coarse grater. For every dozen cucumbers grate one good-sized onion. After all is grated pour off the water which has collected, measure it and for as much water as you pour off add the best cider vinegar. Season with pepper and salt to your taste. Should the vinegar be too sharp dilute with the cucumber water; if it is too thin use less vinegar. Put in jars like fruit—no heating required.

GOOSEBERRY CATSUP.

Five pints of vinegar, four pounds of green gooseberries, one-half pound of brown sugar, one-half pound of raisins, one-quarter pound of let them lie in salt water a short time. If large, cut in two and scrape out the seeds, grate on a coarse grater. For every dozen cucumbers grate one good-sized onion. After all is grated pour off the water which has collected, measure it and for as much water as you pour off add the best cider vinegar. Season with pepper and salt to your taste. Should the vinegar be too sharp dilute with the cucumber water; if it is too thin use less vinegar. Put in jars like fruit—no heating required.

GOOSEBERRY CATSUP.

Five pints of vinegar, four pounds of green gooseberries, one-half pound of brown sugar, one-half pound of raisins, one-quarter pound of currants, one-quarter pound of common salt, two ounces of mustard, two ounces of onions, one-half ounce chillies; one-half ounce allspice, one-half ounce ground ginger, one-half ounce of ground mace, one-half ounce ground turmeric, one nutmeg. Boil the vinegar, currants, onions, gooseberries and chillies till quite soft; then pour through a fine sieve on the remaining ingredients.

RED-PEPPER CATSUP.

Cut up red peppers and place them in a preserving kettle until it is full; then cover with the best cider vinegar and boil until the peppers have dropped to pieces. After removing from the fire, as soon as the sauce is cool enough, rub it through a wire sieve. It is much

better without salt or any other condiments, and is of a beautiful scarlet color, and so thick that it must be put for use in large-mouthed bottles or jars. This will keep fresh for years. It should boil slowly for at least four hours.

LEMON CATSUP.

One pound and a quarter of salt, quarter of a pound of ground mustard, one ounce each of mace, nutmeg, cayenne and allspice, one gallon of cider vinegar, eight or nine garlic cloves, fifteen large lemons. Slice the lemons; add the other ingredients; let simmer from twenty to thirty minutes; place in a covered jar; stir every day for seven or eight weeks, strain then, bottle, cork and seal.

COLD CATSUP.

Half peck ripe tomatoes peeled and cut fine; one cup grated horse-radish; one small cup salt; one small cup brown and white mustard seed mixed; two tablespoonfuls black pepper, ground; two red peppers without seeds, cut fine; one ounce celery seed; one cup chopped onions; one teaspoonful each of ground cloves and mace; two teaspoonfuls cinnamon, one cup brown sugar, one quart best cider vinegar. Mix all together thoroughly, without boiling, and put away in small jars. It can be used at once, and is a delicious relish with cold or hot meats.

CHILLI SAUCE.

Eighteen large ripe tomatoes, eight red peppers, one onion; chop fine; add four cups vinegar; four tablespoonfuls sugar, two tablespoonfuls salt, one tablespoonful ginger, one tablespoonful each of cloves, cinnamon, allspice and nutmeg; boil one hour. This makes about three quarts.

HOT SAUCE FOR MEATS.

Four onions, two cups of sugar, thirty-two tomatoes, one quart of vinegar, four peppers, two tablespoonfuls of salt, two tablespoonfuls of cinnamon, two tablespoonfuls of cloves, three tablespoonfuls of red pepper; cook, strain and bottle.

MINT SAUCE.

Mix one tablespoonful of white sugar to half a teacup of good vinegar; add the mint and let it infuse for half an hour before sending to the table. Serve with roast lamb or mutton.

EGG SAUCE.

Take yolks of two eggs boiled hard; mash them with a tablespoonful of mustard, a little pepper and salt, three tablespoonfuls of vinegar and three of salad oil. A tablespoonful of catsup improves this for some. This sauce is very nice for boiled fish.

FISH SAUCE.

One quarter of a pound of fresh butter, one tablespoonful of finely chopped parsley, a little salt and pepper and the juice of two lemons. Cream the butter; mix all well together, adding at the least a teaspoonful of mayonnaise. Less lemon juice may be used if preferred.

TOMATO SAUCE

Nine ripe tomatoes, peeled and cut small, a red pepper chopped fine, one teacup of vinegar, two tablespoonfuls brown sugar, one tablespoonful of salt, one teaspoonful ginger, one of cloves, one of allspice; put vinegar in last; stew one hour.

PEPPER SAUCE.

Four dozen green peppers, five onions, one handful of garlic, three tablespoonfuls of grated horseradish, two quarts best cider vinegar, one quart of water. Put the whole into a kettle on the fire and boil until soft enough to mash in a sieve with a spoon, then add two tablespoonfuls of black pepper, one tablespoonful each of allspice powdered, mace pulverized, one-half tablespoonful of cloves pulverized and one teaspoonful of salt. Place the mixture on the fire and let boil ten minutes. Pass all the spices through a sieve before adding to the peppers.

TOMATO MUSTARD.

One peck of ripe tomatoes; boil with two onions, six red peppers, four cloves of garlic, for one hour, then add a half pint or half pound of salt, three tablespoonfuls of black pepper, half ounce ginger, half ounce allspice, half ounce of mace, half ounce of cloves, then boil again for one hour longer, and when cold add one pint of vinegar and a quarter pound of mustard, and if you like it very hot, a tablespoonful of cayenne.

HORSE RADISH SAUCE.

Grate very fine a root of horse radish; with two tablespoonfuls of it mix a teaspoonful of salt and four tablespoonfuls of cream, stir briskly and add by degrees a wineglass of vinegar.

SHIRLEY SAUCE.

Four quarts of tomatoes, four spoonfuls of salt, four of black pepper, one-half spoonful cayenne pepper, one-half of allspice, three spoonfuls of mustard, all simmered slowly in one quart of vinegar for three hours. Bottle when cold. Put one teaspoonful of olive oil in each bottle just before corking to preserve it.

SAUCE FOR ROAST BEEF.

Grate horse raddish on a grater into a basin, add two tablespoonfuls cream, with a little mustard and salt, mix well together, add four tablespoonfuls of the best vinegar and mix the whole thoroughly. The vinegar and cream are both to be cold.

CELERY SAUCE.

Wash six or eight heads and take off the outer leaves; cut the heads up into bits three or four inches long. Stew them until tender in half a pint of broth or white gravy, then add two spoonfuls of cream and an ounce of butter rolled in flour; season with pepper and salt and simmer the whole together. The leaves will do to flavor soup that is to be strained.

MUSTARD SAUCE.

One cup of sugar, one cup of vinegar, one tablespoonful of butter, four eggs and one tablespoonful of mustard; beat the eggs well, mix all together, turn into a new tin pail or basin and boil in water same as custard, only to a cream, not thick. Strain through a thin cloth and it is done.

COMMON ONION SAUCE.

Take four or five white onions, half a pint of hot milk, one ounce of butter, pepper and salt to suit your taste. Peel the onions and boil them till they are tender, press the water from them and chop them very fine. Have the milk hot, pulp the onions with it, add the butter; pepper and salt to suit your taste.

TOMATO SOY.

Slice green tomatoes, put a little salt on them and leave them in a large dish to drain, then add half as much onions cut up as you have tomatoes; vinegar enough to keep from burning, and spice to suit the taste—allspice, black pepper, mustard, ginger and red pepper; boil half an hour; when cold pour off the vinegar and add fresh.

TOMATO RELISH.

Twenty-five tomatoes (ripe and peeled), four onions, eight peppers (seeds taken out), chopped fine with onions, eight cups of vinegar, four tablespoonfuls sugar, two of salt. Boil gently one hour.

SALAD SAUCE.

Rub the yolks of cold, hard boiled eggs through a coarse sieve with a wooden spoon, mix with a tablespoonful of cream or water, then add two

tablespoonfuls of olive oil or melted butter; when thoroughly mixed add by degrees a teaspoonful of fine salt rolled; the same quantity of mustard—French, Tarragon or Anchovy is best—and three tablespoonfuls of white wine vinegar; when mixed into a smooth paste pour down the side of the salad bowl, but do not stir it until the salad is ready to be eaten. The whites of eggs cut in various forms may be used to garnish the top of the salad. The greens should be freshly gathered, carefully picked over and laid in cool water an hour or two and dried in a napkin before being laid in the dish.

CHILLI SAUCE.

Take one peck tomatoes (ripe) peeled, twelve onions (if liked), three red and three green peppers; chop all fine, add nearly a half cup ot salt, one tablespoonful each of cinnamon, cloves, allspice and mace. Put all in a large pot or pan and boil two hours, stirring frequently; when cooked add one quart of vinegar and a pint bottle of Worcestershire sauce and let it just boil, then bottle hot.

VINEGAR SAUCE.

Two tablespoonfuls of vinegar, two of sugar, two of flour, one of butter, one of vanilla; stir all together with a little water till it makes a smooth paste; add nearly a pint of boiling water, stirring gently, let it come to a boil; add one well-beaten egg. Set aside for use.

PREPARED MUSTARD.

Two tablespoonfuls of mustard, one of flour; mix thoroughly while dry. Have a teacup two-thirds full of strong mustard; fill with water.

GREEN TOMATO SAUCE.

Cut up two gallons of green tomatoes; take three gills of black mustard seed, three tablespoonfuls of dry mustard, two and a half of black pepper, one and a half of allspice, four of salt, two of celery seed, one quart each of chopped onions and sugar, and two and a half quarts of good vinegar, a little red pepper to taste. Pulverize the spices and boil all together until well done.

HORSE RADISH FOR WINTER.

In the fall mix the quantity wanted in the following proportions: A coffee cup of grated horse radish, two tablespoonfuls of white sugar, a half teaspoonful of salt and a pint and a half of cold vinegar; bottle and seal. To make horse radish sauce, take two tablespoonfuls of the above, add one dessert spoonful olive oil (or melted butter or cream) and one of prepared mustard.

stir the flour and mustard into it and let it boil until as thick as custard; remove from the fire and add a teaspoonful of sugar.

NASTURTIUM SEED.

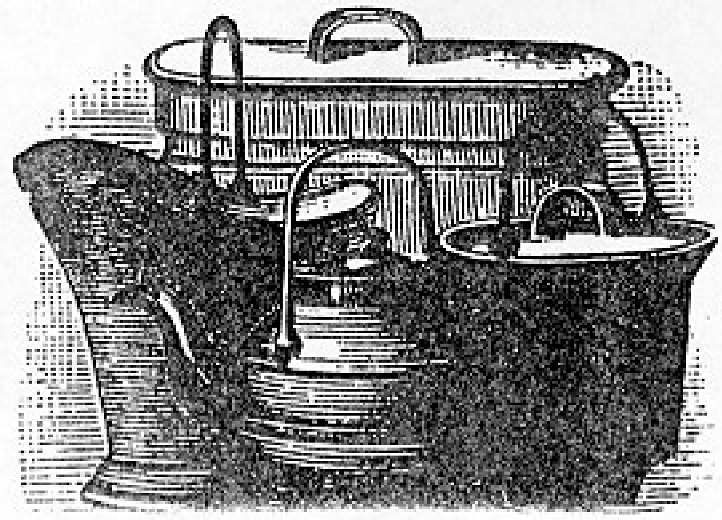
Take the green seed after the flower has dried off, lay it in salt and water two days, in cold water one day; pack in bottles and cover with scalding vinegar seasoned with mace and white peppercorns, and sweetened slightly with white sugar. Cork and set away four weeks before you use them. A good substitute for capers.

GRAVY SAUCE.

To have gravy always on hand, you must do as the French do, namely, save gristle, and every bone left from cold meat or fresh. The bones must be chopped small and put on to stew with enough water to cover. Leave the fat on until you need to use the gravy. By this means it will keep longer.

FRENCH MUSTARD.

Slice an onion in a bowl and cover it with good vinegar; after two days pour off the vinegar, add to it a teaspoonful of cayenne pepper, a teaspoonful of salt, a tablespoonful of sugar and mustard enough to thicken; set on the stove until it boils; when cold it is fit for use.



SOYER SAUCE.

One spoonful mustard, same olive oil, half cup catsup.

BROWN GRAVY SAUCE.

Three onions sliced and fried in butter to a nice brown. Toast a large, thin slice of bread slowly until quite hard and of a deep brown. Take these, with any piece of meat, bone, etc., and some herbs, and set them on the fire with a pint and a half of water, and stew down until it is as thick as gravy. Season, strain, and set in a cool place until you want to use it. It will be found very nice to warm up any kind of cold meat, or for veal cutlets.

CAPER SAUCE.

One cup of the liquor in which meat has been boiled, two teaspoonfuls of flour, rubbed smooth in a little water; salt to taste; two tablespoonfuls of butter, two dozen capers, or green nasturtium-seed; heat the liquor to boiling, and skim before stirring in the flour, which must be perfectly free from lumps, and rubbed smooth in cold water; stir until the sauce thickens evenly. When it has boiled about a minute, add the butter gradually, stirring each bit in well before putting in more; salt and drop in the capers. Let it just boil, and turn into a sauce-boat.

ONION CREAM SAUCE.

Boil three or four white onions until tender; mince fine; boil half pint of milk; add butter half size of an egg; salt and pepper to taste, and stir in minced onion, and a tablespoonful of flour which has been moistened with milk.

MINT SAUCE.

Two tablespoonfuls green mint chopped very fine, one tablespoonful white sugar, half a cup of best vinegar; put sugar and vinegar into a sauce-boat, and stir in the mint; let it stand fifteen minutes before serving.

PRESERVES AND MARMALADES.

One great defect in preserving fruits is overboiling; of course they must be done through, but strawberries and the small fruits, such as raspberries, are spoiled if more than slightly cooked. Over sugaring is quite as great a defect as overboiling. Pound for pound of sugar to fruit is hardly a good rule to go by, because it differs so entirely in sweetness. For currants and plums this amount may be used, but for other fruits the sweetness becomes cloying. A fair rule in preserving sliced or whole fruit is to make a syrup of one and one-half pounds of sugar to one of water, which in volume should be once and a half more than that of the fruit.

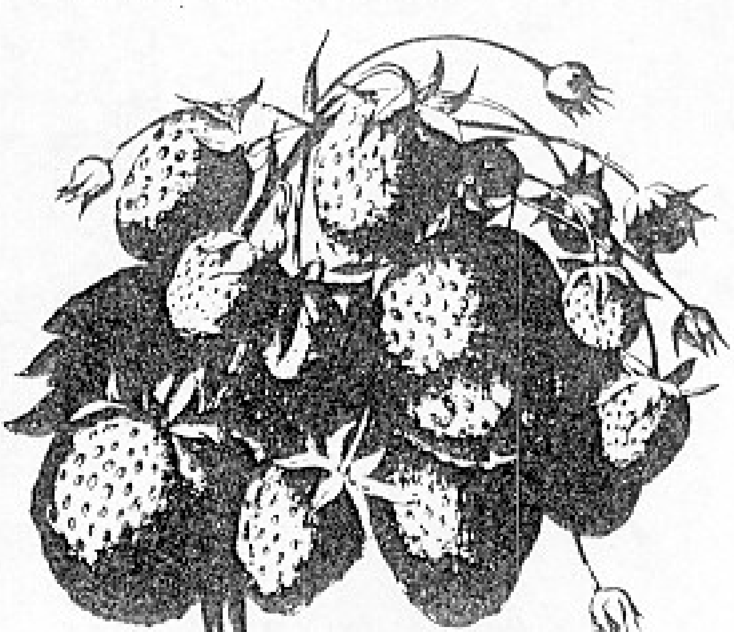
The following tables gives the time or number of minutes that each kind of fruit should be boiled: Boil cherries moderately five minutes; boil raspberries moderately six minutes; boil blackberries moderately six minutes; boil plums moderately ten minutes; boil strawberries moderately eight minutes; boil whortleberries five minutes; boil pie plant, sliced, ten minutes; boil small sour pears, whole, thirty minutes;

boil Bartlett pairs, in halves, twenty minutes; boil peaches, in halves, eight minutes; boil peaches, whole, fifteen minutes; boil pineapples, sliced half an inch thick, fifteen minutes; boil Siberian or crab apples, whole, twenty-five minutes; boil sour apples, quartered, ten minutes; boil ripe currants six minutes; boil wild grapes ten minutes; boil tomatoes twenty minutes. The amount of sugar to a quart jar should be—For cherries, six ounces; for raspberries, four ounces; for Lawton blackberries, six ounces; for field blackberries, six ounces; for strawberries, eight ounces; for whortleberries, four ounces; for quinces, ten ounces; for small sour pears, whole, eight ounces; for wild grapes, eight ounces; for peaches, four ounces; for Bartlett pears, six ounces; for pineapples, six ounces; for Siberian or crab apples, eight ounces; for pie plant, ten ounces; for sour apples, quartered, six ounces; for ripe currants, eight ounces; for plums, eight ounces.

When fruit which is white and clear in color is wanted as a preserve, such as quinces or pears, the whole operation must be carried on as rapidly as possible. Everything must be ready. Just as soon as the fruit is pared or sliced it must at once be cooked. The contents in a jar cannot be too hot. A very easy method of doing this is to place the clean jars, when empty, in a vessel of water which is kept on the full boil while the fruit is being introduced into these jars from the preserving kettle. To take the hot fruit from one vessel to the other without this precaution is to run a useless risk. Take out the jar from the boiling water containing the preserve just as rapidly as possible, and when it is piping hot screw on the lid. Many think that a crust of mold found on the top of a preserve does no harm, as it can be removed. Moldy preserves are not always ruined, but it gives a bad taste to the preserves. A sure prevention of mold is to take white of an egg and wet slightly both sides of a piece of letter paper, sufficiently large to cover over the top of the preserves snugly.

Plums and fruit of which the skin is liable to be broken do better to be put in little jars, with their weight of sugar, and the jars set in a kettle of boiling water till the fruit is done. See that the water is not high enough to boil into the jars. When you put preserves in jars lay a white paper, thoroughly wet with brandy, flat upon the surface of the preserves, and cover them carefully from the air. If they begin to mold scald them by setting them in the oven till boiling hot. Glass is much better than earthen ware for preserves; they are not half as apt to ferment.

In making marmalades, if put up in small quantities and for immediate use, three-quarters of a pound of sugar to one pound of fruit is sufficient; but if desirable to keep them longer, a pound of sugar to a pound of fruit is a better proportion. As in preserves, the best sugar should be used. Put up in tumblers or small jars.



APPLE PRESERVES.

Weigh equal quantities of good brown sugar and of apples; peel, core and mince them small; boil the sugar, allowing to every three pounds a pint of water; skim it well and boil it pretty thick; then add the apples, the grated peel of one or two lemons, and two or three pieces of white ginger. Boil till the apples look clear and yellow. This preserve will keep for years.

BARBERRY PRESERVES.

Few are aware that barberries preserved in common molasses are very good for common use. Boil the molasses, skim it, throw in the barberries and simmer until they are soft. If you wish to lay by a few for sickness, preserve them in sugar. Melt the sugar, skim it, throw in the barberries; when done soft, take them out and throw in others. For preserving, the sugar should be melted over a fire moderate enough not to scorch it. When melted it should be skimmed clean and the fruit dropped in, to simmer until it is soft.

CHERRY PRESERVES.

Common sour cherries are best; stone and take pound of sugar to pound of fruit; take half of your sugar and sprinkle over the fruit, let it stand about an hour, pour into a preserving kettle, boil slowly ten minutes, skim out the cherries; add remainder of sugar to the syrup; boil, skim and pour over the cherries; the next day drain off the syrup, boil, skim, add the cherries, boil twenty minutes and seal up in small jars.

CURRANT PRESERVES.

Ten pounds currants, seven pounds sugar. Take the stems from seven pounds of the currants, and press the juice from the other three pounds. When the juice and sugar are made into a hot syrup, put in the currants and boil until thick and rich.

BLACK CURRANT PRESERVES.

Gather the currants upon a dry day; to every pound allow half a pint af red currant juice and a pound and a half of finely pounded loaf sugar. With scissors clip off the heads and stalks; put the juice, currants and sugar in a preserving pan; shake it frequently till it boils; carefully remove the fruit from the sides of the pan and take off the scum as it rises; let it boil for ten or fifteen minutes. This preserve is excellent.

CITRON PRESERVES.

Peel and cut the citron in pieces an inch square, boil in weak alum water until soft, drain off the water and add one pound of sugar to each pound of citron; to every five pounds of the preserve add one pound of raisins and one lemon sliced; dissolve sugar; when hot add the fruit, and simmer slowly for one hour. The raisins may be left out, if preferred.

CANTELOPE RIND PRESERVES.

Keep the rinds of cantelopes or watermelons in strong brine until you wish to preserve them; then boil in fresh water until the salt is removed. Soak or boil a short time in weak alum water, then boil again in fresh water until there is no taste of alum left. Make a rich syrup of two pounds of white sugar to each of rind. When the syrup has boiled until well clarified, drop the rind in, and boil an hour. Lemon flavoring may be added and a few drops of citric acid to prevent sugaring.

FIG PRESERVES.

Take weight of ripe figs in sugar, the peel of one lemon and juice of two, to five or six pounds of figs. Let the figs soak in cold water twelve hours, then simmer in water until tender, take them out and drain. To each pound of sugar add a teacup of cold water; boil and skim until clear. Put in the figs and simmer ten minutes. Take out the figs and spread them in the sun for a short time, while you add the juice and peel of the lemons and a small teaspoonful of ginger to the syrup, and

boil until thick, then put in the fruit and boil fifteen minutes more. Fill your jars about three-fourths with the fruit, and fill up with hot syrup. Any kind of fruit is good, cooked until clear and tender in a thick syrup, laid in the sun until dry, then packed in boxes dusted with sugar, and a white paper between each layer.

Fig pickles are nice and may be made in the same way with much less sugar, a little vinegar and spices.

GINGER PRESERVES.

Pare roots of green ginger and lay in cold water fifteen minutes; boil in three waters (changing hot for cold every time) until very tender; drain and lay in ice water. For the syrup allow one and a quarter pounds of sugar for every pound of ginger, and a cup of water for every pound of sugar. Boil and skim until the scum ceases to rise. When the syrup is cold, wipe the ginger dry and drop it in. Let it stand twenty-four hours and then drain and reheat the syrup. Then, when blood warm, put in the ginger and let it stand for two days. Then reboil the syrup and pour it over the ginger scalding hot. In a week drain off again; boil and add again while hot to the ginger; cover closely. It can be used in about two weeks.

MOCK GINGER PRESERVES.

Cut into strips the thick rind of a watermelon, trim off the green and cut out the inside until the rind is firm; cover with water, into which throw enough soda to make the water taste of it; let it stand from twelve to twenty-four hours; take out, boil in clear water until a straw will go easily through; drain; put into a syrup made of good brown sugar, very strongly flavored with pounded ginger; let boil slowly until the syrup penetrates the rind. This is almost as good as ginger preserve.

A beautiful nice preserve may be made by cutting the rind into fancy shapes, and substituting white sugar and lemons cut in thin rounds for the ginger and brown sugar. Soda makes the rind more brittle than alum or lime.

GRAPE PRESERVES.

Pick from the stem, wash, drain and weigh; take the same amount of white sugar; put in a bright tin dish-pan; stir the grapes and sugar together; set in the oven until it is hot, then place on the stove stirring continually from the bottom until it boils; set one side of the pan off the stove; have the other side hot and with a long-handled skimmer skim the seeds off as they rise on the cool side. In this way you can remove all the seeds. Be very careful not to let them burn. Wild grapes may be cooked in the same way.

GOOSEBERRY PRESERVES.

The tops and tails being removed from the gooseberries, allow an equal quantity of finely powdered loaf sugar, and put a layer of each alternately into a large deep jar; pour into it as much dripped red currant juice as will dissolve the sugar, adding its weight in sugar. The next day put all in a preserving pan and boil it.

MELON RIND PRESERVES.

Cut the rinds into small strips or squares; take equal weight of sugar and rinds; boil two hours slowly, and put into pots for use. Any rinds can be preserved in this way, and are very nice for cakes or mince pie. Lemon peel boiled with the rinds adds to the flavor. Lemon peel may be candied by boiling it with sugar and exposing it to the air until the sugar crystallizes.

ORANGE PRESERVES.

Take any number of oranges, with rather more than their weight in white sugar. Slightly grate the oranges and score them round and round with a knife, but do not cut very deep. Put them in cold water for three days, changing the water two or three times a day. Tie them up in a cloth, boil them until they are soft enough for the head of a pin to penetrate the skin. While they are boiling place the sugar on the fire with rather more than half a pint of water to each pound; let it boil for a minute or two, then strain through muslin. Put the oranges into the syrup till it jellies and is a yellow color. Try the syrup by putting some to cool. It must not be too stiff. The syrup need not cover the oranges, but they must be turned, so that each part gets thoroughly done.

PRESERVED ORANGE OR LEMON PEEL.

Peel the oranges and cut the rinds into narrow shreds; boil till tender; change the water three times; squeeze the juice of the orange over the sugar; put pound to pound of sugar and peel; boil twenty minutes all together. Lemons may be preserved in the same way.

PEACH PRESERVES.

Pare and stone your fruit and cut in halves; weigh it, and allow one pound of sugar to one pound of fruit; crack peach stones, extract the kernels and put a few into your syrup (for flavoring) while cooking. Put a layer of sugar in the kettle first, then a layer of fruit, and so on until all is used; set where it will warm slowly until the sugar is melted and the fruit hot through; boil steadily until the peaches are tender and clear; take out with a perforated skimmer and lay on large flat dishes, crowding as little as possible. Boil the syrup almost to a jelly—that is clear and thick, and skim; fill your jars two thirds full of the fruit, pour on the boiling syrup and when cold cover with brandied tissue paper, then with cloth, lastly with thick paper tied tightly over them. The peaches should be ready to take off after half an hour boiling; the syrup boils fifteen minuates longer; stir often to let the scum rise, and skim.

Pears are put up the same, only pared. Leave stems on and fruit whole.

TO PRESERVE CLING-STONE PEACHES.

Take the finest peaches, pare them nicely, halve them and put in a bowl; have their weight of loaf sugar sprinkled over them and let them stand for several hours. Put them in the preserving kettle, add a little water and let the peaches remain until thoroughly scalded. Take them out with a ladle, pouring off the syrup. Boil and skim the syrup until it is clear and rich; return the fruit to the kettle and cook there gently until it is clear.

PEAR PRESERVES.

Peel and quarter large pears, and allow one pound of sugar to one pound of fruit; stick one clove to a pear in the pieces. Boil the sugar with one pint of water to the pound; put in some bits of lemon peel and when the syrup has boiled up clear, put the pears in and let them heat through; take them out, let cool and put back to cook until soft. Small ones can be put up whole with a clove in the end.

PLUM PRESERVES.

Allow to every pound of fruit a pound of sugar; put into stone jars alternate layers of fruit and sugar, and place the jars in a moderately warm oven. Let them remain until the oven is cool. If prepared at tea time let them remain until morning; then strain the juice from the plums, boil and clarify it. Remove the fruit carefully to glass or china jars; pour over the hot syrup and carefully cover with egg, tissue paper, or thick white paper, or bladder tied closely down. Or preserve same as peaches.

QUINCE PRESERVES.

Pare, quarter and core the fruit, saving the skins and cores. Put the quinces over the fire with just enough water to cover them, and simmer until perfectly tender, but do not let them break. Take out the fruit and spread on dishes to cool; add the parings and cores to the water in which the quinces were boiled, and cook one hour; then strain through a jelly-bag, and to each pint of this liquor allow a pound of sugar. Boil and skim this, then put in the fruit and boil fifteen minutes. Take it off the fire and let it stand in a deep dish twenty-four hours, then

drain off the syrup and let it boil again; put in the quinces and cool fifteen minutes. Take out the fruit and spread on dishes to cool; boil down the syrup thick; put the fruit in jars until two-thirds full, then cover with the syrup.

STRAWBERRY PRESERVES.

Select the largest and finest strawberries. Hull them, weigh and allow to each pound one pound of the best double refined loaf sugar finely powdered. Divide the sugar into two equal portions. Put a layer of strawberries into the bottom of a preserving kettle and cover them with a layer of sugar, until half the sugar is in. Next set the kettle over a moderate fire and let it boil till the sugar is melted. Then put in, gradually, the remainder of the sugar, and, after it is all in, let it boil hard for five minutes, taking off the scum with a silver spoon; but there will be little or no scum if the sugar is of the very best quality. Afterwards remove the kettle from the fire and take out the strawberries very carefully in a spoon. Spread out the strawberries on large, flat dishes, so as not to touch each other, and set them immediately in a cold place or on ice. Hang the kettle again on the fire, and give the syrup one boil up, skimming it if necessary. Place a fine strainer over the top of a mug or pitcher, and pour the syrup through it. Then put the strawberries into glass jars or tumblers; pour into each an equal portion of the syrup. Lay at the top a round piece of white paper dipped in brandy. Seal the jars tightly.

A shorter method is to put them in a preserving kettle over a slow fire until the sugar melts; boil twenty-five minutes fast; take out the fruit in a perforated skimmer and fill a number of small cans three-quarters full; boil and skim the syrup five minutes longer; fill up the jars and seal while hot; keep in a cool dry place.

Raspberries may be preserved as above. Also large, ripe gooseberries. To each pound of gooseberries allow one and a half pounds sugar. Bury them in a box of sand or keep in a dark, cool place.

GREEN TOMATO PRESERVES.

Eight pounds small green tomatoes (pierce each with a fork), seven pounds sugar, the juice of four lemons, ginger and mace mixed, one ounce. Heat all together slowly, and boil until the fruit is clear. Take it from the kettle in a perforated skimmer, and spread upon dishes to cool. Boil the syrup until thick, put the tomatoes in jars and pour syrup over them hot. Keep in a cool, dry place. These taste much like foreign preserves.

RIPE TOMATO PRESERVES.

Seven pounds round yellow or egg tomatoes, peeled; seven pounds sugar; juice of three lemons; let them stand together over night; drain off the syrup and boil it, skimming well; put in the tomatoes, and boil gently twenty minutes; take out the fruit with a perforated skimmer and spread upon dishes; boil the syrup down until it thickens, adding, just before taking it up, the juice of three lemons; put the fruit into the jars and fill up with hot syrup. When cold seal up.

TOMATO FIGS.

Scald and skin pear-shaped (or any small sized) tomatoes, and to eight pounds of them add three pounds of best brown sugar; cook without water until the sugar penetrates and they have a clear appearance, take out, spread on dishes, and dry in the sun, sprinkling on a little syrup while drying; pack in jars or boxes, in layers, with powdered sugar between. Thus put up they will keep for any length of time and are nearly equal to figs.

PRESERVED AND DRIED FRUIT.

Use one pint of sugar for a pint of fruit, put them together in a porcelain kettle, a layer of the fruit at the bottom. When the sugar is dissolved, let them boil one or two minutes, skim from the syrup, and spread on plates to dry in a partly cooled oven. Boil the syrup until thickened, pour it over the currants and dry it with them. Pack in paper-sacks, or a box lined with paper, and keep in a dry and cool place. Heat engenders moths, but a few sprigs of dry sassafras will keep fruit secure from their intrusion. Blackberries, cherries, plums and currants may be dried in this way, or any of the small fruits.

MARMALADE OF MIXED FRUITS.

Pare equal quantities of apples, pears, peaches and quinces; cut them fine and put them to boil with a pint of water to six pounds of fruit; let them cook thoroughly; take out and mash well; clean the kettle and put them back with half their weight in sugar, and cook slowly two hours.

CIDER APPLE-SAUCE.

Pare, quarter and core sweet apples sufficient to fill a gallon porcelain kettle; put with them a half-gallon boiled cider and let it come to a boil. Place a plate over them and boil steadily but not rapidly until they are thoroughly cooked, testing by taking one from under the edge of the plate with a fork. Do not remove the plate until done, or the apples will sink to the bottom and burn.

APPLE MARMALADE.

Pare, core and cut the apples in small pieces; put them in water with some lemon juice to keep them white; after a short interval take them out and drain them; weigh and put them in a stewpan with an equal quantity of sugar; add grated lemon peel, the juice of a lemon, some cinnamon sticks and a pinch of salt. Place the stewpan over a brisk fire and cover it closely. When the apples are reduced to a pulp, stir the mixture until it becomes of the proper consistency.

APPLE BUTTER.

Take one bushel of sour apples (do not peel), wash them, cut out the cores and decayed spots, put into a tin boiler (kept for the purpose), and boil until tender; run them through a sieve, return to the boiler with water in which they were cooked and let boil for an hour till as thick as apple sauce; add cinnamon, cloves and brown sugar to suit the taste, two quarts or a little more of apple jelly; after cooking a little longer, put while hot into jars.

CHERRY MARMALADE.

Stone the cherries and pulp them thoroughly through a coarse sieve; to every three pounds of pulp add half a pint of currant juice: add three-quarters of a pound of sugar to each pound of fruit; mix together and boil until it will jelly. Put in cans or glasses.

GRAPE MARMALADE.

Pick the grapes from the stem, put into a preserving kettle, covering them with water. Boil until perfectly soft, then pour into a colander and rub them until all the pulp passes through; then to each pint of pulp add one pound of clarified sugar and boil until the proper consistency. Put it into jars and cover as preserves.

ORANGE MARMALADE.

Take three pounds of sweet oranges and two pounds of lemons, with the same weight of sugar. Take a thin paring from the fruit and cut into fine chips; boil them until quite tender; scrape off the pulp from the inner skins, and pick out the seeds. Have a dish with a little water, in which put skins and seeds to extract all the juice possible. When all is ready, strain the water from the chips and skins, and use one and a half pints for the syrup. Boil pulp, chips, etc., twenty minutes, and cover when cold.

PEACH MARMALADE.

Take ripe freestone peaches. Pare, stone and quarter them; to a

pound of fruit allow three-quarters of loaf sugar and half ounce of bitter almonds. Blanch the almonds in scalding water and pound them until smooth. Scald the peaches in a very little warm water; mash them; mix them with the sugar and almonds, and put the whole into a preserving kettle. Boil it to a thick, smooth paste. Skim and stir it well, and keep the kettle covered as much as possible. Fifteen minutes will be sufficient to boil them. When cold, put up in glass jars.

PLUM MARMALADE.

Stone them and put into the kettle with a pound of sugar to each pound of fruit; put a small cup of cold water in first to prevent burning. When the fruit begins to soften, take a potato-masher and mash it to a pulp, without taking it from the fire. Let it boil gently for fifteen or twenty minutes, not longer than twenty. Take from the fire and put into jars.

PLUM CHEESE.

Boil plums in sufficient water to prevent burning; then wash and strain; to every pound of pulp add half a pound of clear brown sugar; cook as you would jam, stirring to prevent burning. It can be cut in slices, and is a nice addition for lunch.

QUINCE MARMALADE.

Poor quinces, unfit for other uses, can be washed and cut in small pieces, coring but not paring them. Allow three-quarters of a pound of sugar and a teacup of water to a pound of fruit, and boil slowly two hours, stirring and mashing it fine. Strain through a colander, and put in glasses or bowls. Peaches, crab apples or sour apples may be used in the same way.

PICKLES.

SOUR AND SWEET.

When making pickles use good, sharp vinegar, or the pickles will be insipid. Keep them from the air and see that they are well covered with the vinegar. Boil in a porcelain kettle; never in brass or metal. Parboil the pickles first, then let them get perfectly cold, and pour on the scalding hot vinegar. A small lump of alum dissolved and added to the vinegar when scalding the first time makes them crisp and green. To make them sharp and crisp they should be parboiled in one vinegar, and then a second vinegar poured over them when ready to put in the crock. Keep in a dry, cool place, either in stone or glass. If put away in stone jars, put a plate or saucer over them so as to keep the pickles under vinegar. If white specks appear on the vinegar, drain off and scald, adding a handful of sugar to each gallon of vinegar.

Most people prefer their pickles highly spiced; cloves and cinnamon put in bags are good for this, also bits of horseradish and red or green peppers. The horseradish helps to preserve the life of the vinegar, but if it will after this persist in losing its strength, pour off the old and replace by new, poured over the pickles scalding hot. Ginger is the most healthy of all spices, cloves are the strongest, after these allspice and cinnamon. Proportion these or the pickles will be black in color and too hot for the palate. Mustard seed is also an improvement. Never put up pickles in anything that has held grease, or do not let them freeze; if they do they will be entirely spoiled.

Sweet pickles may be made of any fruit that can be preserved, including the rind of ripe cucumbers or melons. The proportions of sugar to vinegar is three pints to a quart. Make into a syrup and pour over the ripe fruit. With some fruits it is necessary that they may be scalded or steamed; with others it is not. Very ripe peaches or plums do not need steaming, but pears, apples, cucumber and melon rinds are better steamed and the hot vinegar syrup afterward poured over them. With these it is also necessary the spices should be put in bags or the fruit will be much discolored. Crabapples make particularly good pickles, though many seem to think only of making them into jelly or preserves.

In making pickles use none but the best cider vinegar. The vinegar should always be two inches or more above the vegetables, as it is sure to shrink, and if the vegetables are not thoroughly immersed in pickle they will not keep. They should be examined every month or two and soft pieces removed. If there is much tendency to soften, it is advisable to strain off the vinegar, add to each gallon a cup of sugar, boil it and return it to the pickle jar while hot. The occasional addition of a little sugar keeps pickles good and improves them. Spices in pickles should be used whole, slightly bruised, but preferably not ground; if ground they should be tied up in thin muslin bags. Most pickles, if well kept, improve with age by the vinegar losing its raw taste and the flavor of the spices improving and blending.

To strengthen weak vinegar, if in pickles, turn it off, heat it scalding hot, put it on the pickles and when lukewarm put in a small piece of alum the size of a filbert and a brown paper four inches square wet with molasses. If it does not grow sharp in two weeks it is past recovery and must be thrown away. If in winter, freeze it and remove the ice on the surface, for the water alone freezes, leaving the vinegar.

To keep up a constant supply of vinegar: Before the barrel is quite out, fill the barrel with one gallon of molasses to every eleven gallons of soft water. This mixture will become good vinegar in about three weeks. If the barrels stand on end, there must be a hole made in the top, protected with gauze to keep out insects. If standing on the side, the bung-hole must be left open and similarly protected.

A simple method of pickling is to merely put the articles into cold vinegar. This cold vinegar should be used for those that do not require the addition of spice, and such as do not require to be onions, radish pods, horseradish, garlic and eschalots. Half fill the jars with best vinegar, fill them up with the vegetables, and tie down immediately with bladder. These are much better if pickled quite fresh and all of a size. The onions should be dropped in the vinegar as fast as peeled; this secures their color. The horseradish should be scraped a little outside and cut up in rounds half an inch deep. Barberries for garnish; gather fine full bunches before they are quite ripe, pick away all bits of stalk and leaf and injuried berries and drop them in cold vinegar; they may be kept in salt and water, changing the brine whenever it begins to ferment, but the vinegar is best.

To put up cucumbers in brine: Leave at least an inch of stem to cucumbers and wash well in cold water. Make a brine of salt and water strong enough to bear an egg; put the cucumbers in this as they are gathered each day from the vines. Cut a board so as to fit inside of the barrel; bore holes here and there through it, and put this board on the cucumbers with a weight sufficient to keep it down. Each day take off the scum which arises. When wanted for use take out what is necessary and soak them two or three days, or until the salt is out of them, and then pour boiling spiced vinegar over them. A red pepper or two is an improvement if one likes hot pickles.

To harden them after they are taken out of the brine, take a lump of alum and a horseradish cut in strips; put this in the vinegar and it will make them hard and crisp. When you wish to make a few cucumber pickles quick, take good cider vinegar; heat it boiling hot and pour it over them. When cool, they are ready for use.

PICKLED SWEET APPLES.

Take three pounds of sugar, two quarts of vinegar, one-half ounce of cinnamon, one-half ounce of cloves; pare the apples, leaving them whole; boil them in part of the vinegar and sugar until you can put a fork through them; take them out, heat the remainder of the vinegar and sugar and pour over them. Be careful not to boil them too long or they will break.

PICKLED ARTICHOKES.

Boil your artichokes in strong salt and water for two or three minutes; lay on a hair sieve to drain; when cold lay in narrow-topped jars. Take as much white wine vinegar as will cover the artichokes and boil with it a blade or two of mace, some root ginger and a nutmeg grated fine. Pour it on hot, seal and put away for use.

PICKLED BLACKBERRIES.

Seven pounds of fruit, three pounds of sugar, one quart of vinegar, one-half ounce of cloves, one-half ounce cassia buds. When the syrup is boiling add the berries; boil one-half hour; skim out the berries, boil down the syrup and pour it over them.

PICKLED BEANS.

String and break between each bean, wash, put on to boil, cook till they begin to burst open, take off, cool them, then salt as if to use fresh, pack away in a stone jar or nice tub, add tolerable weight; then prepare a weak brine and pour over; cover, and in a few weeks they will be sour.

PICKLED BUTTERNUTS OR WALNUTS.

Gather them when soft enough to be pierced with a pin. Lay them in strong brine for five days changing this twice in the meantime. Drain and wipe dry; pierce each by running a large darning-needle through it, and lay them in cold water for six hours. To each gallon of vinegar allow one cup of sugar, three dozen each of whole cloves and black pepper corns, half as much allspice and a dozen blades of mace. Boil five minutes; pack the nuts in small jars and cover with the scalding vinegar. Repeat this twice within a week; tie up and set away. Good to eat in a month.

PICKLED CABBAGE.

Select solid heads, slice very fine, put in a jar, then cover with boiling water; when cold drain off the water and season with grated horseradish, salt, equal parts of black and red pepper, cinnamon and whole cloves.

SWEET CABBAGE PICKLE.

One and a half gallons sliced cabbage, three quarts of water, three-fourths pound salt, the salt and water to be boiled together, skimmed and poured over the cabbage while boiling hot, which will shrink the cabbage to one gallon. It must be closely covered to stand all night, then dry by being pressed with a coarse cloth; then soak one pint of chopped onions, one-half gallon vinegar, one-half pint grated horseradish, one pod red pepper, one pound sugar, one-half head of garlic, three ginger roots, three tablespoonfuls of turmeric, one-half tablespoonful mustard seed, two pieces mace, a few grains black pepper, a few cloves. These ingredients are to be mixed together in the vinegar; the cabbage remaining, must then be put in the mixture and the whole put in a stone jar and set in a pot of water and boiled about four hours.

PICKLED CAULIFLOWERS.

Take solid and white cauliflower; pull apart in bunches, spread on an earthen dish; lay salt over them, and let them stand three days; then put into earthen jars and pour boiling salt and water over them; let them stand all night, then drain, put into glass jars and fill up with white vinegar prepared the same as for the onions.

SPICED CAULIFLOWER.

Select small, white, close bunches, boil in scalding brine three minutes, drain, and sprinkle thickly with salt; brush off when dry; cover for two days with cold vinegar, setting the jar in the sun; pack carefully in glass jars; prepare and throw over them scalding vinegar, seasoned thus: To one gallon, one cup of white sugar, twelve blades of mace, a tablespoonful celery seed, two dozen white pepper corns and some bits of red pepper pods, a tablespoonful of coriander seed and the same of white mustard. Boil five minutes. Scald once a week for three weeks, tie up and set away; place a small plate on top of jar inside to keep the cauliflower under the liquid.

PICKLED CHERRIES.

Five pounds of cherries, stoned—leave a few pits for flavoring; one quart of vinegar, two pounds of sugar, one-half ounce of cinnamon, one-half ounce of cloves, one-half ounce of mace; boil the sugar, vinegar and spices together and pour hot over the cherries.

CELERY PICKLES.

Take good sized cucumbers, slice on a vegetable slicer quite thin and pour a weak brine, boiling hot, over them and let stand twenty-four hours; then to a gallon of vinegar add an ounce of white mustard seed, one of celery seed and half a teaspoonful of pulverized alum; boil and turn over the pickles. Put in old pickle bottles and seal, or in a jar with a cloth over, rinsing the cloth occasionally.

CHOPPED PICKLE.

One gallon green tomatoes, four large onions, three red peppers and three green ones, leaving in a few of the seeds. Chop all fine; throw in a big handful of salt; mix well together and let it stand over night. In the morning drain dry and add one pound of brown sugar, one tablespoonful each of black pepper, ground cloves and allspice; half a pint of white mustard seed and one-quarter of an ounce of celery seed. Pour over three pints of cider vinegar, boiling hot. This is excellent. Put into jars or wide-mouthed bottles and cork tightly.

PICKLED CORN.

Boil the corn on the cob; when cool cut it from the cob; place on the bottom of a jar a layer of salt and a layer of corn until the jar is full; cover with a cloth, board and weight; when wanted for use soak in water until fresh; then cook and it is like fresh corn.

BOTTLED CHOW-CHOW.

Take fifty small pickles, two quarts of silver onions, two quarts of green string beans, one dozen green tomatoes, three heads of cauliflower; let the onions stand in brine twelve hours, then peel. If the beans are large, break them. Slice the green tomatoes, cut up the cauliflowers; let all stand in brine twenty-four hours. To one gallon of vinegar use one pound of mustard (common is the best), mix it with a little vinegar, and add it to the rest. One or two tablespoonfuls of oil of mustard, one tablespoonful of cayenne pepper—use more spices if preferred. Tie the spices in a white cloth, and boil in the vinegar, before adding the mustard. It can be put in pickle jars in alternate layers; fill three-quarters full; when filling the jars add here and there a little red and green pepper; fill up with the mustard; make air tight.

MUSTARD CHOW-CHOW.

Two heads of cabbage, two heads of cauliflower, one dozen cucumbers, six roots of celery, six peppers, one quart of small white onions, two quarts green tomatoes; cut into small pieces and boil each vegetable separately until tender, then strain them. Two gallons of vinegar, one-fourth pound of mustard, one-fourth pound of mustard seed, one pot of French mustard, one ounce of cloves, two ounces of turmeric; put the vinegar and spices into a kettle and let them come to a boil; mix the vegetables and pour over the dressing.

PICKLED CUCUMBERS.

Wash with care the cucumbers, and place in jars. Make a weak brine (a handful of salt to a gallon and a half of water); when scalding hot turn over the cucumbers and cover; repeat this process three mornings in succession, taking care to skim thoroughly. On the fourth day have ready a porcelain kettle of vinegar, to which has been added a piece of alum the size of a walnut. When scalding hot, put in as many cucumbers as may be covered with the vinegar; do not let them boil but skim out as soon as scalded through, and replace with others, adding each time a small piece of alum. When this process is through, throw out the vinegar, and replace with good cider or white wine vinegar; add spices, mustard seed and red pepper. Sort the pickles and

place them in stone or glass jars, turn over the hot spiced vinegar; seal and put away the jars not wanted for immediate use. Pickles thus prepared are fine and crisp at the expiration of a year. Those that are kept in open-mouth jars may be covered with a cloth, which will need to be taken off and rinsed occasionally.

SPICED CUCUMBER PICKLE.

Two dozen cucumbers, slice and boil in vinegar enough to cover; boil one hour; set aside in the hot vinegar. To one gallon cold vinegar allow one pound brown sugar, one tablespoonful each of cinnamon, ginger, black pepper and celery seed, one teaspoonful mace; one teaspoonful allspice and cloves, one tablespoonful turmeric, one tablespoonful grated horseradish, one tablespoonful sliced garlic, half teaspoonful cayenne pepper; put in the cucumbers and stew two hours; it will be ready for use as soon as cold; if it is liked thicker, put in double the quantity of cucumbers.

RIPE CUCUMBER PICKLES.

Peel the cucumbers, halve them, scrape the inside and soft part out with a silver spoon, salt them down for twelve hours; wipe dry with a towel and cut in pieces or strips; have a layer of mustard seed, cloves and pepper, then a layer of cucumbers. A piece of horseradish is an addition to them. Boil enough vinegar to cover all; pour on after they are cold; after a week boil some vinegar again and pour over them.

SLICED CUCUMBER PICKLE.

Gather the cucumbers before the seeds are very large; pare and throw into ice-cold water for one hour; then slice as thin as possible, on a cabbage cutter; sprinkle well with salt; tie up in a coarse cloth and lay in a colander under a heavy weight to drain over night. Next morning mix through them plenty of brown and white mustard-seed; pack in jars and cover well with cold cider vinegar. Put in a cool place. Should a white scum rise on the vinegar, draw it off and boil and skim well, or substitute other vinegar. Pour it over them cold. This retains the flavor of the cucumber.

EAST INDIA PICKLES.

One-half peck sliced green tomatoes, one-half peck sliced white onions, twenty-five small cucumbers, two cauliflowers cut in small branches; sprinkle salt over these plentifully and let stand twenty-four hours, and then drain well; mix half a cup of grated horseradish root with half an ounce of turmeric (get at the drug store), half an ounce each of ground cinnamon and cloves, one ounce of ground pepper, one pint of ground mustard seed, one pint of brown sugar, two bunches of chopped celery. Put this mixture into a porcelain kettle in layers with the vegetables. Cover with cold cider vinegar and boil slowly for two hours. The turmeric gives the pickles the yellow color peculiar to East India pickles, and in taste and appearance they cannot be distinguished from the genuine.

PICKLED EGGS.

Sixteen eggs, one quart of vinegar, one-half ounce of black pepper, one-half ounce of Jamaica pepper, one-half ounce of ginger; boil the eggs twelve minutes; dip in cold water and take off the shell; put the vinegar with the pepper and vinegar into a stew pan and simmer ten minutes; place the eggs in a jar, pour over the seasoned vinegar boiling hot, and when cold tie them down with a bladder to exclude the air; ready for use in a month.

ENGLISH MIXED PICKLES.

One-half peck of small, green tomatoes, three dozen small cucumbers, two heads of cauliflower, one-half peck of tender string beans, six bunches of celery, six green peppers, and a quart of small, white onions. Chop the vegetables quite fine, sprinkle with salt, and let stand over night; to six or seven quarts of vinegar add one ounce each of ground cloves, allspice and pepper, two ounces of turmeric and four ounces of mustard seed; let the vinegar and spices come to a boil, put in the vegetables and scald until tender and a little yellow.

FRENCH PICKLES.

Slice a peck of green tomatoes and six large onions, half pint salt, two pounds brown sugar, half pound white mustard seed, two tablespoonfuls each of ground allspice, cloves, cinnamon, ginger, mustard, one teaspoonful red pepper, five quarts vinegar, two of water. Sprinkle salt over the tomatoes and onions; let stand over night, drain in the morning; add the water and one quart vinegar. Boil the tomatoes and onions twenty minutes and drain, boil the four quarts of vinegar with the other ingredients fifteen minutes; put in jars, pour over the hot dressing, seal and keep in a cool dry place.

GERMAN PICKLES.

Take two or three dozen pickles (good sized ones), half a peck of small grape leaves and some dill; wash the pickles and leaves; take a small jar and lay in the bottom of it a layer of leaves and then of pickles, and a little dill; lay in alternate layers; make a salt water brine of very warm water, enough to cover the pickles; do not make it too salty; put a plate in the jar, and lay on it a heavy stone. In about a week the pickles will be sour.

PICKLED GRAPES.

Select small bunches of ripe, firm grapes and pack in the jars in which they are to be kept. To a quart of vinegar, add a half pound of sugar; one-fourth of a pound of stick cinnamon, and an ounce of allspice, whole. Boil, and when cold, turn over the grapes. They will keep without sealing. Stone jars, holding a gallon each, may be used for these pickles. A piece of white cotton cloth should be spread over the clusters, and a plate placed on top, to keep them under the vinegar.

HODGE PODGE.

Slice one peck of green tomatoes, sprinkle lightly with salt and let it stand two hours, then drain off the liquid and throw it away, and to the tomatoes add the following ingredients: Half a gallon good vinegar, one dozen large onions (sliced), four large pods of green pepper (minced fine), half pound of white mustard seed, quarter pound black mustard seed, and one teaspoonful each of cloves, mace, ginger, black pepper, cinnamon, and celery seed. It is best to put this pickle up in small jars and seal. It is ready for use as soon as made.

INDIA PICKLE.

Take three quarts of vinegar, quarter pound mustard, half ounce of black pepper, one ounce cloves, one ounce allspice, one ounce turmeric, one ounce ginger, one ounc cayenne pepper, handful of salt and the same of sugar; boil for twenty minutes. When cold put in the vegetables, cucumbers, onions, cauliflower cut up small, and cover closely. If the liquid should seem thin boil again and add more mustard in three weeks after making.

PICKLED LEMONS.

Wipe six lemons, cut each into eight pieces; put on them a pound of salt, six large cloves of garlic, two ounces of horseradish, sliced thin, likewise of cloves, mace, nutmeg and cayenne, a quarter of an ounce each, and two ounces of flour of mustard; to these add two quarts of vinegar; boil a quarter of an hour in a well-tinned saucepan; or, which is better, boil it in a strong jar, in a kettle of boiling water; or, set the jar on the hot hearth till done. Set the jar by, and stir it daily for six weeks; keep the jar close covered. Put pickles into small bottles.

BOTTLED MIXED PICKLES.

Take equal quantities of onions, cucumbers, green tomatoes, carrots

and cauliflowers; cook them in salted water until a fork will go in them easy, but they must not be soft; then have hot vinegar, with black or red peppers in; while the pickles are hot lay them, a few of each, alternately, in the glass case until full, then pour over them hot peppered vinegar, and seal. Be sure to have the can hot as for canning fruit.

MIXED YELLOW PICKLES.

Three hundred small cucumbers, four green peppers sliced fine, two large or three small heads of cauliflower, three heads of white cabbage shaved fine, nine large onions sliced, one large root horseradish, one quart of green beans cut one inch long, one quart of green tomatoes sliced; put this mixture in a pretty strong brine twenty-four hours; drain three hours, then sprinkle in one-fourth pound black and one-fourth pound of white mustard seed; also one tablespoonful black ground pepper; let it come to a good boil in just vinegar enough to cover it, adding a little alum. Drain again, and when cold, mix in one-half pint of ground mustard; cover the whole with good cider vinegar; add turmeric enough to color, if liked.

PICKLED MUSHROOMS.

Clean them with water and flannel, throw them into boiling salt and water in a stew-pan and boil for a few minutes. Drain them in a colander and spread out on a linen cloth, covering them with another. Put into bottles with a blade or two of mace, and fill up with white vinegar, pouring some melted mutton fat on the top, if intended to keep long.

PICKLED MANGOES.

Cut a round piece out of the top of small round musk melons and extract the seeds. Then tie the pieces on again with a thread and put in a strong brine for ten days. Drain and wipe, put them into a kettle with nice leaves under and over them, adding a small piece of alum and put over a slow fire to green, keeping them tightly covered. To fill, make a dressing of scraped horseradish, white mustard seed, mace, nutmeg pounded, green ginger cut small, pepper, turmeric and sweet oil. Fill the mangoes with this mixture, putting a small clove of garlic into each one of them, replacing the pieces at the opening and sewing them in with strong thread. Put into stone jars and pour boiling vinegar over them.

PICKLED VEGETABLE MANGOES.

For one dozen mangoes, take one cup each of white and black mustard seed, one handful of horseradish, one tablespoonful each of cloves, mace, cinnamon, black pepper, celery seed, and one cup of sugar; mince a small head of cabbage fine; pour hot vinegar over it and let it stand half an hour, then drain off, and when cold, put the mixture together, adding small beans and cucumbers, and fill the mangoes. Place them in the kettle with seam up, and scald gently with vinegar.

MUSTARD PICKLES.

Six green peppers, six quarts of small onions, six quarts of small cucumbers, six quarts of pickled cauliflowers, four quarts of sliced cucumbers; pour over this a brine, one tablespoonful of salt to one quart of water, until all are well covered; let this stand twenty-four hours; drain off, and they are ready for the dressing. Dressing: To each quart of vinegar, add six tablespoonfuls of best mustard, one and a half cups of brown sugar, one-half cup of flour, one-half ounce of turmeric and the same of curry powder; boil all together five minutes and pour over the pickles. The dressing should be the consistency of thick, sour cream when cold, and if not, add more flour and boil up again. These pickles can be kept in crocks, covered tightly with thick paper. One gallon of vinegar will make dressing enough for eight or nine quarts of pickles; if you have any left bottle for meats. It is an elegant salad dressing, or can be used again another year.

MUSK MELON PICKLES.

Take them when just ripe; pare and slice about an inch and a half thick; put them in alum water one night; take out and drain well; allow three pounds sugar to three pints vinegar; boil well and skim; pour over the melons; pour off the syrup and heat and pour back nine mornings, the last time add cinnamon and cloves to suit the taste; boil the syrup down till just enough to cover the pickles.

SPICED NUTMEG MELON.

Select melons not quite ripe; open, scrape out the pulp, peel and slice; put the fruit in a stone jar, and, for five pounds of fruit take a quart of vinegar and two and a half pounds of sugar; scald vinegar and sugar together, and pour over the fruit; scald the syrup and pour over the fruit for eight successive days. On the ninth, add one ounce of stick cinnamon, one of whole cloves and one of allspice. Scald fruit, vinegar and spices together, and seal up in jars. This pickle should stand two or three months before using. Blue plums are very nice prepared in this way.

PICKLED NASTURTIONS.

Soak for three days in strong salt and water; then strain and pour boiling vinegar over them, omitting the spice.

PICKLED ONIONS.

Select small silver-skinned onions, remove with a silver knife all the outer skins, so that each onion will be perfectly white and clean. Put them into brine that will float an egg and leave them for three days; drain, place in a jar, first a layer of onions three inches deep, then a sprinkling of horseradish, cinnamon bark, cloves, and a little cayenne pepper; repeat until the jar is filled, in proportion of half a teaspoonful of cayenne pepper, two tablespoonfuls each chopped horseradish and cloves and four teaspoonfuls cinnamon bark to a gallon of pickles; bring the vinegar to boiling point, add brown sugar in the proportion of a quart to a gallon, and pour hot over the onions.

SPANISH PICKLED ONIONS.

Cut onions into slices, put a layer of them into a jar, sprinkle with cayenne pepper and salt, then add another layer of onions and proceed as before. Proceed in this way until the jar is full, and pour cold vinegar over all till covered. They will be fit for use in a month.

PICKLED PEACHES.

Take nice fair peaches, wipe them clean with a woolen cloth and place them in a stone jar; to seven pounds of fruit take three pounds nice yellow coffee sugar, one pint good cider vinegar, three ounces cinnamon in sticks, one ounce of cloves; boil the sugar, vinegar and spices together and pour over the fruit while hot; cover them and let them stand three days; pour off again; bring to a boil; then put the fruit and all together and boil till they are transparent; set away in a cool, dry place. Sweet apples may be pickled in same way.

PICKLED PEARS.

Ten pounds of pears, three pounds of light brown sugar, one quart of vinegar, one ounce of cinnamon, one ounce of cloves (ground); put all together and boil till the pears are tender; skim the pears out and let the syrup boil a half an hour longer.

PICKLED PEPPERS.

Take large green ones (the best variety is the sweet pepper). Make a small incision at the side; take out all the seeds, being careful not to mangle the peppers. Soak in brine that will float an egg for two days, changing the water twice. Stuff with chopped cabbage and chopped onions, seasoned with mustard seed and spices. Sew up incision, place in jar and cover with cold spiced vinegar. Many cut off the top of the red pepper, then tie it on again, and when ready to be used the top has

only to be removed and the pickle is ready.

PEPPER HASH.

Equal proportions of green and ripe peppers, cabbages and cucumbers; mince them fine, separately, and then mix them well together; season with horseradish and salt; cover with very strong vinegar.

PICCALILLI.

One peck green tomatoes, quarter peck sliced onions—sliced and salted over night—one handful scraped horseradish, ounce turmeric powder, ounce each of cloves and cinnamon, quarter pound whole pepper, pound each of mustard seed and flour mustard; put in a large preserving kettle alternate layers of tomatoes, onions, cauliflower, some sliced green pickles which have been cut up and salted over night, also one or two green peppers, with all the other ingredients; cover the whole with vinegar; boil fifteen or twenty minutes, stirring carefully. Pour off all the water that forms on the pickle when they lay in the salt.

PICKLED PLUMS.

Seven pounds plums, four pounds sugar, two ounces stick cinnamon, two ounces cloves, one quart vinegar, and a little mace; put in the jar first a layer of plums then a layer of spices alternately, scald the vinegar and sugar together, and pour it over the plums; repeat three times for plums (only once for cut apples and pears); the fourth time scald all together; put them into glass jars and they are ready for use.

PICKLETTE.

Take four large, firm cabbages chopped fine, one quart onions chopped, two quarts vinegar, or enough to cover the cabbage, two pounds brown sugar, two tablespoonfuls each of ground mustard, black pepper, cinnamon, turmeric and celery seed, one tablespoonful each of allspice, mace and alum, pulverized; pack the cabbage and onions in alternate layers, with a little salt between them; let it stand twenty-four hours; then scald the vinegar, sugar and spices together and pour over the cabbage and onions after draining them well; do this three mornings in succession and on the fourth put all over the fire and boil five minutes; put in jars and keep cool.

RAGAN PICKLE.

Two gallons of cabbage, sliced fine; one gallon of chopped green tomatoes; twelve onions, also chopped; one gallon best vinegar; one pound brown sugar; one tablespoonful of black pepper; half an ounce turmeric powder; one ounce celery seed; one tablespoonful ground allspice; one teaspoonful ground cloves; one-quarter pound white mustard; one gill of salt. Boil all together, stirring well, for two hours. Take from the fire, and add the spices; then put in air-tight jars. Set in a cool, dry place, and this delicious pickle will keep all winter.

PICKLED RAISINS.

Take two pounds of large, fine raisins on the stems, add one pint of vinegar and half a pound of sugar; simmer over a slow fire half an hour.

SPANISH PICKLE.

Four dozen large cucumbers, four large green peppers, one-half peck of onions, one-half peck of green tomatoes; slice the whole and sprinkle over them one pint of salt; allow them to remain over night, then drain them; put the whole into a preserving kettle and add the following ingredients: Sliced horseradish according to judgment, one ounce of mace, one ounce of white pepper, one ounce of turmeric, one ounce of white mustard seed, half an ounce of cloves, half an ounce of celery seed, four tablespoonfuls of dry mustard, one and a half pounds of brown sugar; cover the whole with vinegar and boil one hour.

SWEET FRUIT PICKLES.

To every seven pounds of fruit allow three and one-half pounds of sugar and one pint of cider vinegar, two ounces of whole cloves, two of stick cinnamon. This is for peaches, pears, apples or musk melons. Peaches, pears and apples should be pared only, not divided. Then in each stick two whole cloves. The cinnamon should be boiled in the vinegar. Put the prepared fruit into a stone jar and pour the vinegar, scalding hot, over it. Repeat this, for three mornings. These sweet pickles will be found delicious, and will keep any length of time. The melons should be cut in strips, as if to serve fresh on the table, and should not be too ripe. Simmer them thirty minutes slowly in the prepared vinegar, and they will need no further attention except to keep them closely covered. These will keep good a year.

SWEET VEGETABLE PICKLES.

Take one peck of good solid green tomatoes, and onions to suit the taste and fancy, or five quarts of tomatoes and three of onions; peel the onions as for boiling; wash and dry the tomatoes; cut them in thin slices; cut in small pieces, six large green peppers, carefully leaving out the seeds; put the slices in a large pan and sprinkle a pint of fine salt on them; let them stand about twenty-four hours; drain off all the liquor, carefully pressing down the cover; when they are sufficiently drained put in the preserving kettle and cover well with vinegar, prepared thus: Ten or twelve ounces brown sugar to the quart, a tablespoonful each of ground cinnamon and cloves, and a spoonful of crushed white mustard seed; boil well about fifteen minutes, and put in pots or jars.

TOMATO CHOWDER.

A half-bushel of green tomatoes, one dozen onions, one dozen green peppers; chop fine; sprinkle over the mess one pint of salt and let it stand over night. Pour off this brine and cover with good vinegar; let it cook one hour slowly, then drain and pack in a jar. Take two pounds of sugar, two tablespoonfuls of cinnamon, one tablespoonful of allspice, one tablespoonful each of cloves and pepper, a half-teacup of ground mustard, one pint of grated horseradish; mix the sugar, spices, horseradish and mustard with vinegar; heat boiling hot and pour over the other ingredients; put in a cool place, covered tightly. This will keep a year, or longer.

GREEN TOMATO PICKLES.

One peck green tomatoes, one dozen sliced onions; sprinkle well with salt and let them stand until next day, then drain them. Use the following as spices: One small box mustard, half an ounce black pepper, one ounce of whole cloves, and one of white mustard seed. Alternate layers of tomatoes, onions and spices; cover with vinegar. Wet the mustard before putting it in. Boil the whole twenty minutes.

RIPE TOMATO PICKLES.

Take smooth, ripe tomatoes and wash clean in cold water; prick them with a coarse needle; lay compactly in a stone jar until full; then take sufficient pure cider vinegar to cover; heat until boiling, then turn over the tomatoes; have ready a piece of foolscap or smooth brown paper, turn the white of an egg on it, and see that every part of the paper is covered with the egg; put it in the jar (egg side down), and pinch the edges close and cover with paper tied on tight. When cool, put away in a cool, dark place.

CHOPPED TOMATO PICKLE.

Chop green tomatoes up fine; to about three quarts add a scant cup of salt put in alternate layers in a stone jar and let them stand over night; then drain off the water that has accumulated; cover them nearly or quite with vinegar, add half an ounce of whole cloves, half an ounce of celery seed and about half a dozen small onions, chopped; put the whole over the stove and let it come to a scald but not boil. They are ready for use when cold.

TO KEEP TOMATOES WHOLE.

Fill a large stone jar with ripe tomatoes, then add a few whole cloves

and a little sugar; cover them well with one-half cold vinegar and half water; place a piece of flannel over the jar well down in the vinegar, then tie down with paper. In this way tomatoes can be kept a year. Should mildew collect on the flannel it will not hurt them in the least.

PICKLED TURNIPS.

Wash them clean before boiling; do not pare them. If the rind is broken the juice escapes. When cooked take off the outside, slice them like beets and pour hot spiced vinegar over them. They are to be eaten while newly cooked and warm, and are as good as pickled beets.

WATER MELON RIND PICKLES.

Pare them; cut up the inside rind in small squares; then boil in weak ginger water until tender; make a syrup of sugar and vinegar spiced with cloves and cinnamon, and pour on hot three successive mornings. Musk melon rinds may be pickled in the same way.

EXTRACTS AND SYRUPS.

PEACH FLAVORING EXTRACT.

The meats of peach pits, in brandy, make an excellent flavoring extract, resembling that of bitter almonds. Allow one teacup of the meat to two of brandy. Use one teaspoonful of the liquor for a quart of custard, or cake dough.

VANILLA EXTRACT.

Take one ounce each of vanilla and tonka beans; soak the latter in warm water until the skin can be rubbed off; cut all in small pieces and put in a quart bottle with a pint of alcohol and a pint of water. Set it in a warm place for two or three days when it will be fit for use, and quite as good as can be bought at the stores, at much less expense. The bottle can be filled a second time, and the extract will be good.

ORANGE EXTRACT.

Take the white skin from the peel of an orange, put the peel into a bottle, cover with alcohol. It will be ready for use in a day or two.

LEMON EXTRACT.

Cut off the yellow outside peel of five lemons, shave it as thin as you can, put it into a pint of spirits and cork tightly.

TOMATO SYRUP.

Extract the juice of tomatoes; add one pound of sugar to each quart of juice and bottle. In a few weeks it will have the appearance and flavor of pure wine. Mixed with water it is a delightful drink for the sick, as it retains all the well-known properties of the fruit. It will keep for years.

BARBERRY SYRUP.

Strip barberries, cover them with water, put them over the fire, and be careful they do not burn; don't boil them, but when cooked squeeze and strain them carefully; to one pint of warm juice add two pints of sugar; put the sweetened juice into a pitcher, which pitcher put into hot water until the juice is dissolved; then bottle it.

LEMON FLAVORING.

Take a dozen lemons; slice them thin; take ten pounds of best white sugar; place a layer of sugar and one of lemons in an earthen jar; let them remain over night, then pour as much water over them as will make a syrup; place the jar in a kettle of water and let them simmer but not boil; strain and bottle, and you will have a delicious flavoring for winter when lemons are expensive. Lemonade can be made from it by using a few spoonfuls in water. The lemons can be placed on a plate after they are strained from the syrup and used in preserves for flavoring.

LEMON SYRUP.

Take two pounds of loaf sugar and two pints of water, one ounce of citric acid, half-drachm of essence of lemon. Boil the sugar and water together for quarter of an hour and put it into a basin, where let it remain till cold. Beat the citric acid to a powder, mix the essence of lemon with it, then add these two ingredients to the syrup; mix well and bottle for use. Two tablespoonfuls of the syrup are sufficient for a tumbler of cold water, and will be found a very refreshing summer drink.

LEMON PEEL.

One of the nicest flavorings for custards, stewed rhubarb, puddings, etc., is made from the brandy in which lemon peel is soaked. A wide-mouthed bottle should always be kept, in which to put all spare lemon peel; pour brandy over to cover it and keep it corked. This is always ready for use. Another bottle should be kept for some of the spare peel, which should be chopped very fine, and a little salt put over it, to be used for forcemeats or meat flavorings. Also dry some peel in a cool oven, and use this, crumbled fine or grated, for apple sauce and various other things.

ORANGE PEEL.

Cut the fruit into quarters lengthwise, take out the pulp and put the peels in strong salt and water for two days, then take them out and soak for an hour in cold water, afterward put them into a preserving kettle with fresh cold water, and boil till the peels are tender, when they should be put on a sieve to drain. Make a thin syrup of a quart of the water in which they were boiled and a pound of sugar, and simmer the peels in it for half an hour, when they will look clear; pour the peels and syrup in a bowl together to stand till the next day, when you must make as much syrup as will cover them, of the proportion of one pint of water to a pound of sugar, boiling it till it will fall from the spoon in threads; put the peels into the syrup, stir half an hour and take them out, drain on a sieve, and as the candy dries, transfer them to a dish to finish in a warm place. When dry, store them for use. This recipe is useful for any lemon, orange or citron peel, and perfectly wholesome.

DRIED AND CANDIED FRUITS.

SELECTING FRUITS.

Of dried fruits, cherries and peaches are the best; of canned fruits, peaches, plums, large cherries and pineapples; for jellies, currant, raspberry and peach; for jams, raspberry, blackberry, pear and quince. Rhubarb makes a delicious preserve to some, as also do black currants, and yet there are those who can eat neither. Rhubarb can be mixed with any kind of fruit half and half, and in a short time will taste exactly like the fruit with which it is mixed.

DRIED FRUIT.

To keep dried fruit from becoming wormy—after being prepared, as it should always be before putting away, by scalding—as you put it in sacks scatter amongst it pieces of sassafras bark from the root. Tie closely; it will keep for years.

DRIED BLACKBERRIES.

Dry carefully in the sun like apples. Keep in a cool, dry place. This is a cheaper way than any other for preserving them, and they make excellent pies.

DRIED CITRON.

If you want your citron to look like the dried citron, pare and quarter, if large; boil until clear and soft enough to be easily pierced with a fork; take out and drain, then place in a nice syrup of sugar and water and boil until the sugar has penetrated it. Take out and spread on

dishes to dry slowly, sprinkling several times with powdered sugar and turning until dried enough. Pack in jars or boxes with sugar between the layers.

DRIED WATER MELON RINDS.

After preserving, place in the sun and dry. They answer well in puddings and cakes as substitutes for the imported citron.

CANDIED FRUITS.

Make a syrup as for preserves and boil the fruit until tender. Let them stand two days in the syrup. Take out, drain carefully, lay them on plates, sift sugar over them, and dry either in the sun or in a moderately warm oven.

CANDIED CITRON.

Pare and seed the citron; let lay over night in a weak sugar water. Next morning drain through a colander; add to one pound of citron one pound of white sugar; put the sugar on and boil until quite a thick syrup is formed, then drop the citron in and cook down thick; when done, pour out on plates and leave near the stove until dry, then sprinkle with granulated sugar and keep in glass jars. Lemon and orange peel can be prepared in the same way only it is not necessary to lay in sugar water over night.

Preserve citron in the same way, only taking half a pound of sugar; cook until clear and put away for use.

CANDIED ORANGE OR LEMON PEEL.

Soak and boil tender, the same as for preserves: make a thin syrup of a quart of water to a pound of sugar; simmer the peels in it half an hour, pour into a bowl together and let stand until next day, then make a syrup to cover them, of a pound of sugar to a pint of water, boiling it till it will fall from the spoon in threads; put the peel into the syrup, boil half an hour, take out and drain on a sieve, and as the candy dries, transfer to a dish to dry in a warm place.

ORANGE CITRON.

Candied orange peel, or orange citron, is easily made. The only difficulty is to obtain the orange with thick enough peel, the thicker the better. Soak the peel in salt and water a day and night, then freshen the same length of time; make a syrup of sugar, using a pound to each pound of peel, and boil until nearly transparent.

SPICED FRUIT.

SPICED FRUIT.

To seven pounds of fruit, take three good pounds of sugar, one pint of vinegar, cloves, mace and cinnamon to suit taste; sprinkle the sugar over the fruit, let it stand over night, then boil juice, vinegar and spice fifteen minutes. Put in the fruit and boil ten minutes.

SPICED APPLES.

Eight pounds of apples, pared and quartered, four pounds of sugar, one quart of vinegar, one ounce of thick cinnamon, one-half ounce cloves; boil the vinegar, sugar and spice together, put in the apples while boiling, and let them remain until tender (about twenty minutes), then put the apples in a jar; boil down the syrup until thick and pour over them.

SPICED BLACKBERRIES.

To five pounds of berries add two pounds of sugar, one pint of vinegar, two tablespoonfuls of cinnamon, two of cloves, the same of allspice; heat all well together, skim out the fruit and boil one hour; return the fruit and boil fifteen minutes; put in jars and cover tight. Prepare currants in very nearly the same manner, adding another pound of sugar.

SPICED CURRANTS.

One ounce of cinnamon, half an ounce of cloves, one tablespoonful each of mace and allspice, well ground, one pint of vinegar, four pounds of currants and two of sugar. Boil the fruit with spices tied in a bag, and the sugar to a thick syrup. When nearly done add vinegar. Put away in jelly tumblers or glass cans.

SPICED ELDERBERRIES.

To four pounds of sugar, use one pint of vinegar, six pounds of berries; boil one tablespoonful of ground cinnamon, one teaspoonful of ground cloves, one of allspice, in the vinegar; strain vinegar, add sugar, boil up, then add berries; boil two hours.

SPICED GOOSEBERRIES.

Six pounds currants or gooseberries, five pounds sugar, half a pint of vinegar, spices, cloves and cinnamon; boil until thick.

SPICED GRAPES.

Five pounds grapes, three pounds sugar, two tablespoonfuls cinnamon and allspice, half teaspoonful cloves; pulp grapes, boil skins until tender, cook pulps and strain through a sieve, add it to the skins, put in sugar, spice and vinegar to taste; boil thoroughly and cool.

SPICED PEACHES.

Five pound peaches, two of brown sugar, one quart vinegar, one ounce each cinnamon, cloves, mace. Wipe the peaches and boil until done in the vinegar and sugar, then take out, put in spices, boil well and pour over.

SPICED PEARS.

Pare the pears evenly, put from three to four cloves (heads taken off) in each pear, make a syrup of three pounds of sugar, one pint vinegar; tie up cloves, cinnamon (and any other spices one prefers) in a cloth and boil in the syrup; when nearly thick enough put in your pears and cook until they look clear, then put them in a jar and pour syrup over them, and they will keep for years.

SPICED PLUMS.

Nine pounds blue plums, six pounds sugar, two quarts vinegar, one ounce cinnamon; boil vinegar, sugar and spice together, pour over plums, draw off next morning and boil, pour back on plums; repeat the boiling five mornings, the last time boiling the fruit about twenty minutes.

SPICED TOMATOES.

Two pounds of nice ripe tomatoes, one pound of brown sugar, half a pint of good cider vinegar, one dozen cloves and two dozen grains of allspice. Put these ingredients into a preserving kettle and stew them over a slow fire. When they have been in sufficiently long to cook the tomatoes nearly soft, take them up and place them on a dish to cool, but continue boiling the syrup slowly. When the tomatoes become cool put them back into the syrup and boil them until they are of a dark red color, then take them out again, put them on a dish to cool and continue boiling until it is as thick as molasses. When the tomatoes and syrup are both cool put them in jars and tightly seal.

JAMS AND JELLIES.

The fruit must be picked when just ripened, as when too old, it will not form jelly. Look over the fruit, and then put stems and all in a porcelain-lined kettle, or they may be put in a brass or tin kettle, if scoured very bright, and the fruit removed immediately after it is taken from the fire. Use the best refined or granulated sugar, taking care that it has not a bluish tinge; for jelly from bluish-white sugars does not harden well.

If two fruits are combined for jams or jellies, the flavor is much enhanced, as raspberries and currants. To extract the juice, crush a

little of the fruit and put all together in the kettle, but add no water. As it heats, mash with a potato-masher, and, when hot, strain through a jelly-bag. Let all run off that will before squeezing the bag. It will be a little clearer than the squeezed juice. To every pint of this juice add one pound of sugar. Boil the juice twenty-five minutes; add the sugar and boil for five more; put up in glasses. Crab-apple, quince, grapes, etc., are all made in the same way. Allow a teacup of water to a pound of fruit; boil till very tender; then strain through a cloth, and treat as currant jelly. Cherries will not jelly without gelatine, and grapes are sometimes troublesome. Where gelatine is needed, allow a package to two quarts of juice.

For jams the syrup is made as above. Use raspberries, strawberries, or any small fruit, and thoroughly bruise before cooking, as this prevents it from becoming hard. Boil fifteen or twenty minutes before adding the sugar, and then boil half an hour longer. Jams require constant stirring with a wooden spoon, and the closest attention, as they are easily burned, and if in the slightest degree, the flavor is destroyed. Put up in small jars, of either glass or stone, and seal or secure like canned fruits or jellies.

Jelly should be examined toward the end of summer, and if there are any signs of fermentation, reboil. Jelly needs looking after more closely in damp, rainy weather than in dry. If troubled with jelly getting moldy, cover the glasses with buttered paper pressed down closely to the jelly, and paste as usual. To test jelly, drop a little in a glass of very cold water, and if it immediately falls to the bottom, it is done; or drop it on a saucer and set it on ice, and if it does not spread but remains rounded, it is done. A very little butter rubbed with a cloth on the outside of jelly glasses or cans, will enable one to pour in the boiling fruit without breaking the cans. If jelly is not firm let it stand in the hot sun for a few days covered with thin cloth, or window glass. Jellies and jams should be covered with paper dipped in the purest salad oil, and fine tissue paper stretched over the top, cut about two inches larger, and brushed with the white of an egg; then, when dry, they will be perfectly hard and air-tight. They should then be set away in a dry, cool and dark place.

APPLE JAM.

Peel and core the apples, cut in thin slices and put them in a preserving kettle with three-quarters of a pound of white sugar to every pound of fruit; add (tied up in a piece of muslin) a few cloves, a small piece of ginger and a thin rind of lemon; stir on a quick fire for half an hour.

APRICOT JAM.

Pare the apricots, which should be ripe, as thinly as possible; break them in half and remove the stones, weigh the fruit, and to every pound allow the same proportion of loaf sugar; roll the sugar fine, strew it over the apricots, which should be placed on dishes, and let them remain for twelve hours, then put the sugar or fruit into a preserving pan, let them simmer very gently until clear, take out the pieces of apricots singly as they become clear, and as fast as the scum arises carefully remove it; put the apricots in small jars, pour over them the syrup, and put up the same as jelly.

BLACKBERRY JAM.

To each pound of fruit add three-fourths of a pound of sugar; then put together and boil from one-half to three-fourths of an hour.

CHERRY JAM.

To every pound of fruit, weighed before stoning, allow one-half pound of sugar; to every six pounds of fruit allow one pint of red currant juice, and to every pint of juice one pound of sugar. Weigh the fruit before stoning, and allow half the weight of sugar; stone the cherries and boil them in a preserving pan until nearly all the juice is dried up; then add the sugar, which should be crushed to powder, and the currant juice, allowing one pint to one pound of sugar.

WHITE OR RED CURRANT JAM.

Pick the fruit very nicely, and allow an equal quantity of purely powdered loaf sugar: put a layer of each alternately into a preserving pan, and boil for ten minutes; or they may be boiled the same length of time in sugar previously clarified and boiled like candy.

DAMSON CHEESE.

Take twelve pounds of damsons and put them into the oven; when they are soft take out the stones, crack them and then blanch the kernels, then add three and a half pounds of lump sugar; boil about three hours; wet the molds before using them. Weigh the damsons before they are put into the oven.

GOOSEBERRY JAM.

Take what quantity you please of red, rough, ripe gooseberries, take half the quantity of lump sugar; break them well and boil them together for half an hour or more, if necessary.

GRAPE JAM.

Boil ripe grapes to a soft pulp (about one hour and a half will do) and strain through a sieve; weigh them and to every pound of fruit allow three-quarters of a pound of sugar; boil together twenty minutes, stir and strain.

GREEN GAGE JAM.

To every pound of fruit weighed before being stoned, allow three-fourths of a pound of lump sugar. Divide the green gages, take out the stones, and put them into a preserving pan; bring the fruit to a boil, then add the sugar, and keep stirring it over a gentle fire until it is melted; remove the scum as it rises, and just before the jam is done, boil it rapidly for five minutes.

LEMON CONSERVE.

One pound powdered white sugar, quarter pound fresh butter, six eggs, leaving out the whites of two, adding the juice and grated rind of three fine lemons. Put all into a saucepan; stir the whole gently over a slow fire until it gets thick as honey. A delicious spread for bread, biscuit or rolls.

LEMON CHEESECAKES.

Grate the rind of two lemons and squeeze their juice into a bowl; add a quarter of a pound of powdered sugar, quarter of a pound of fresh butter; beat up three eggs, mix altogether, and they will be ready to make into tartlets or open tarts.

PEACH JAM.

Gather the peaches when quite ripe, peel and stone them, put them in a preserving pan, mash them over the fire till hot; rub them through a sieve, and add to a pound of pulp the same weight of pounded loaf sugar, and half an ounce of bitter almonds, blanched and pounded; let it boil ten or twelve minutes. Stir and skim it well.

RASPBERRY JAM.

Three-quarters of a pound of sugar to each pound of fruit; put the fruit on alone or with the addition of half a pint of currant juice to every four pounds of fruit; boil half an hour, mashing and stirring well; add the sugar, and cook twenty minutes more. Blackberry jam is very good made as above, omitting the currant juice.

STRAWBERRY JAM.

To every pound of fruit allow three-fourths pound of sugar, one pint of red currant juice to every four pounds of strawberries. Boil the currant juice with the strawberries for half an hour, stirring all the time; add the sugar and boil twenty minutes more, skimming carefully. The currant juice may be omitted, but it improves the jam.

APPLE JELLY.

Peel and core a quantity of apples and then stew them until there are

no lumps in the mass, strain through a coarse sieve, pressing them all through with the hand. Throw out all tough or woody bits, or the remains of dry bruised places before refilling the sieve. Then take a tin cup and measure the cooked apples, and to every four cups of apples add one cup of fine, dry sugar. Boil until it makes a stiff jam; put in bowls and jars and set away in a cool, dry place. Peach butter of dried peaches can be made in this way, only to every three cups of the peach sauce add one cup of sugar.

Or, take tart juicy apples, cut in pieces, core them if at all defective; add water to just cover them; stew gently till tender; turn into a bag or strainer of cloth; let drain over night, or for several hours; then put back on the stove, heat and skim; add three-fourths pint of sugar to a pint of juice; boil about ten minutes; seal up like jelly.

CALF'S FOOT JELLY.

Take two calves' feet; add to them one gallon of water; boil them down to one quart; strain, and when cold remove all fat; then add the whites of six or eight eggs (well beaten), half a pound of sugar and the juice of four lemons; mix well. Boil for a minute, constantly stirring; then strain through a flannel bag.

CURRANT JELLY.

Allow three-quarters pound of sugar to one of juice: boil juice hard fifteen minutes; heat the sugar in the oven, add to juice and boil hard five minutes; put into molds, sprinkle with finely-pulverized sugar (to prevent mold) and seal either hot or cold.

UNCOOKED CURRANT JELLY.

To one pint of currant juice add one pound of granulated sugar, stir the juice very slowly into the sugar until the sugar is dissolved, then let it stand twenty-four hours and it will be stiff jelly. Tie it with paper dipped in brandy, and set it in the sun. Half a bushel of currants makes twenty-two and one-half pint glasses of jelly.

RED CURRANT JELLY.

Strip carefully from the stems some quite ripe currants of the first quality, and mix with them an equal weight of good sugar reduced to powder; boil these together quickly for exactly eight minutes; keep them stirred all the time, and clear off the scum as it rises; then turn the preserve into a very clean sieve, and put into small jars the jelly which runs through it, which will be delicious in flavor and of the brightest color. It should be carried immediately, when this is practicable, to an extremely cool but not damp place, and left there till perfectly cold. The currants which remain in the sieve make an excellent jam, particularly if only one part of the jelly be taken from them. In Normandy, where the fruit is of richer quality, this preserve is boiled only one minute, and is both firm and beautifully transparent.

ELDERBERRY JELLY.

For six pounds of berries take four pounds of sugar; make same as currant jelly.

GOOSEBERRY JELLY.

Boil six pounds of green, unripe gooseberries in six pints of water (they must be well boiled but not burst too much); pour them into a basin and let them stand covered with a cloth for twenty-four hours, then strain through a jelly-bag, and to every pint of juice add one pound of sugar. Boil it for an hour; then skim it and boil it for a half hour longer with a sprig of vanilla.

GRAPE JELLY.

Take perfectly fresh grapes, then remove the stems and put the berries over the fire in an earthenware pan or porcelain lined kettle; crush a few berries on the bottom of the kettle to prevent burning; let them boil up, remove from the fire and hang up in the jelly bag to drain; when the juice is all drained off, weigh it and return it to the kettle and fire; boil it twenty minutes, skimming when necessary; then add three-quarters of a pound of sugar to every pound of juice, and boil it till it is thick enough to suit. If one fancies pale-colored jellies, a very good one may be made from Concord grapes, by removing the skins before cooking the grapes and then proceeding as above.

WILD GRAPE JELLY.

Wash and pick the grapes from the stems just before they are ripe; put them over the fire in porcelain-lined kettle, with a little water, to keep them from burning, and stew a few moments, then mash gently with a silver spoon; strain, and to every pint of juice allow a pound of white sugar; put the juice back on the fire and boil for twenty minutes; pour in sugar—lump or granulated—and stir constantly until all is dissolved; then, without any more boiling, fill the jelly glasses.

LEMON JELLY.

Four ounces of butter, one pound of sugar, six eggs, the grated rind and juice of two lemons. Put all in a pan over a slow fire, gently stirring until it is as thick as cream; then pour it into jars, cover, and keep in a dry place. Or, one pound of sugar, one and a half pints of boiling water, one ounce of isinglass soaked two or more hours in half a pint of cold water, half a gill of wine, the juice and grated rind of three lemons; pour the boiling water on the isinglass, stir it, and add the other ingredients; then pour in molds wet in cold water.

LEMON SNOW JELLY.

Dissolve one box of gelatine in nearly a quart of boiling water, then add the juice of five lemons and enough of sugar to sweeten to taste; strain and set aside until nearly cool. Beat the whites of five eggs and whip into the jelly; turn into a dish and let it stand until cold. After it becomes cold decorate with pieces of red jelly.

MUSCADINE JELLY.

Pulp the muscadines, saving all the pulp and juice, and to one quart throw in a dozen or so of the hulls to give it a rich crimson color. Without the hulls the jelly will have a muddy color, and too much of them gives a dark ugly red. After putting in the hulls, if you find there is not juice enough to prevent scorching, add a little water, then set on a brisk fire and let it cook from twenty to thirty minutes; remove from the fire and strain through a flannel bag. This is the only time it must be strained. To one quart of juice add one pint of sugar, and return to the fire and let it boil hard twenty minutes without stirring. Then take out a little in a saucer and let it cool; if not stiff enough let it boil longer.

ORANGE JELLY.

Grate the peel of five fine oranges and two lemons into a bowl; squeeze the juice of them into it; boil one pound of sugar in a quart of water, and, when boiling hard, pour it over two ounces of isinglass; stir until it is dissolved; add the juice to it, strain through coarse muslin, and let it stand until half cold; then pour gently into molds which have been wet with cold water. Before turning out put the molds into warm water; loosen the edges with a spoon.

PEACH JELLY.

In order to make good jelly, wipe the down off your peaches, which should be free stones, and not too ripe; cut them in quarters; crack the stones and break the kernels small; put the peaches and kernels into a covered jar; set them in a kettle of boiling water and let them boil till they are soft; strain them through a jelly bag; allow a pound of loaf sugar to a pint of juice; put the juice into a preserving kettle and boil fifteen or twenty minutes briskly; then add the sugar and dissolve; skim carefully and pour into glasses. After canning peaches

if there is more juice than can be used; put sugar in, the same as for jelly, and make it the same as above. Any kind of jelly can be made from the juice of fruits when there is more than can be used for canning.

PIE PLANT JELLY.

Pick the pie plant and wash, but do not peel it, cut in strips, put in the kettle; add enough water to cook until soft, strain the juice off and weigh; add sugar pound for pound; cook ten minutes, or as thick as desired.

PINE APPLE JELLY.

Take one pine apple, or one can of pine apples, and cut very fine, and boil ten minutes in a pint of water which has half a box of gelatine dissolved in it; add the juice of a lemon and sugar to your taste; turn into a mold, and set in a cool place twenty-four hours.

PIG OR CALVES' FOOT JELLY.

Take the feet, strike them against a hard substance to get the hoof off, and then put them in clean water without salt, and let them remain so three days, changing water night and morning. On the fourth day take out early and have ready on the fire a pot of water; put the feet in and boil hard for three or four hours, filling up the pot with boiling water as fast as it boils down. About a half hour before it is done, allow the water to boil down to the quantity of jelly you wish to make. When done the meat will fall from the bones when touched with a fork; it must then be all lifted out, and strain the liquor in bowls, and set in a cool place until the next morning; then skim off all the grease upon the jelly and sides of the bowls, else the jelly will be dark. Now put the jelly on to boil, and when it boils up pour in one large cup of whisky, one pound of sugar, one tablespoonful each of cinnamon and mace, and flavor with lemon or orange peel. Let it continue to boil fifteen minutes. Pour in a cup of water; take it off; let it set five minutes; return it to the fire and let it again come to abo il. Have ready your jelly bag, pour it back and forth as fast as it drips out, the oftener the clearer the jelly will be. Finally, hang it up and let drip slowly.

RHUBARB JELLY.

Wash the stalks well but do not peel them; cut into pieces about an inch long, put them into a preserving kettle with about half enough water to cover and boil to a soft pulp; strain through a jelly bag. To each pint of this juice add a pound of sugar (loaf is best); boil again, skimming often, and when it jellies on the skimmer remove it from the fire and put into pans.

PLUM JELLY.

Pour boiling water over the plums sufficient to cover them. Pour off the water immediately and drain. Then put the plums in a preserving kettle with boiling water enough to cover them again, and boil until they begin to open and some of the juice is extracted; pour off the liquid and strain it; to each pint of juice add one pound of white sugar; return to the kettle and boil from twenty to thirty minutes, as it may require. The plums may be used for sauce or pies and are as good as though they had not gone through the above operation.

WILD PLUM JELLY.

Fill your preserving kettle with the plums, and cover them with water; let come to a boil, and as soon as they begin to burst drain off the water and throw it away (it is not fit for use on account of its extreme bitterness); fill up your kettle again with water, and let boil till the plums have cooked to pieces; drain off, and to every pint add one-half pint of sugar and cook until it jellies

For jam, take the pulp left after you drained off the water for your jelly, and for every pound add a pound of sweetening, equal proportion of sugar and molasses, or all sugar, if preferred, and cook until reduced to a jam. This makes a most delightful tart for winter.

QUINCE JELLY.

Peel, cut up and core some fine ripe quinces; put them in sufficient cold water to cover them and stew gently till soft, but not red. Strain the juice without pressure, weigh, and to every pound of juice allow one pound of crushed sugar; boil the juice twenty minutes, add the sugar and boil again until it jellies—about a quarter of an hour; stir and skim well all the time; strain through thin cloth into your jelly glasses and when cold cover it. The remainder of the fruit can be made into marmalade with three-quarters of a pound of sugar and a quarter of a pound of juicy apples to every pound of quinces, or it can be made into pies or tarts.

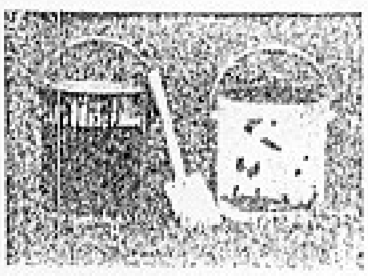
STRAWBERRY JELLY.

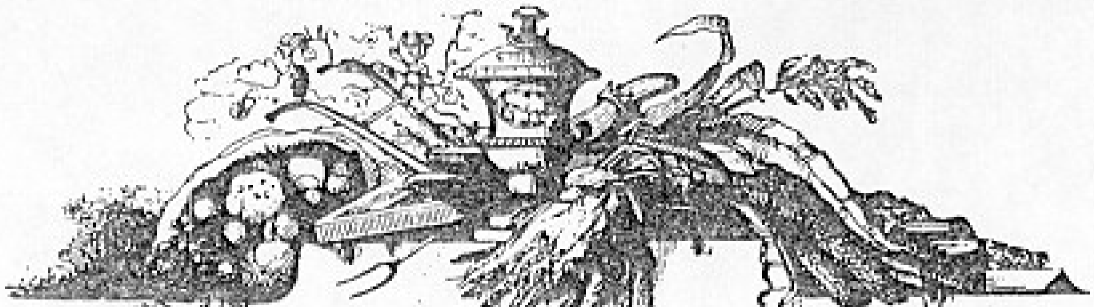
Take small berries, do not stem them, but strain through a cloth or jelly strainer; put the juice on the stove, and boil twenty minutes. Then measure a pint of juice and a pint and a third of sugar, set on and boil from fifteen to twenty minutes longer. Let it drop off the spoon; when it drops off thick and heavy it will jelly. Then take it off and fill the glasses, having previously dipped them in cold water, so that the jelly will turn out nicely.

POPULAR SCIENCE JULY, 1945

Paint Can Becomes Sand Pail

IF YOU have a discarded paint container with the handle still attached, it can be transformed into an attractive and sturdy sand pail with little effort. Remove the rim with a close-cutting can opener, leaving no sharp edges, and clean up the can with paint remover. Give the exterior two coats of white paint and decorate with decalcomanias, paint the interior a light yellow, and the pail is ready for use on the beach or backyard sand pile.—MRS. W. A. BLACK.





Pickles, Sauces and Catsups.—The formulas in this section are arranged as follows: Pickles, Sauces, Mustards, Catsups.

Pickles.—An Excellent Way of Preserving Cucumbers.—Salt and water, 1 lb. of lump sugar, the rind of 1 oz. of ginger, cucumbers. Choose the greenest cucumbers, and those most free from seeds; put them in strong salt and water, with a cabbage leaf to keep them down; tie a paper over them, and put them in a warm place till they are yellow; then wash them and set them over a fire in fresh water, with very little salt, and another cabbage leaf over them; cover very closely, but take care they do not boil. If they are not a fine green, change the water again, cover them as before, and make them hot. When they are a good color, take them off the fire and let them cool; cut them in quarters, take out the seeds and pulp, and put them into cold water. Let them remain for 2 days, changing the water twice each day to draw out the salt. Put the sugar, with half a pint of water, in a saucepan over the fire; remove the scum as it rises, and add lemon peel and ginger with the outside scraped off: when the syrup is tolerably thick, take it off the fire, and when cold, wipe the cucumbers dry, and put them in. Boil the syrup once in 2 or 3 days for 3 weeks; strengthen it if required, and let it be quite cold before the cucumbers are put in. Great attention must be paid to the directions in the commencement of this recipe, as, if these are not properly carried out, the result will be far from satisfactory. This recipe should be used in June, July or August.

An Excellent Pickle.—Equal quantities of medium-sized onions, cucumbers and sauce apples; 1½ teaspoonfuls of salt, ¾ teaspoonful of cayenne, 1 wineglassful of soy, 1 wineglassful of sherry; vinegar. Slice sufficient cucumbers, onions and apples to fill a pint stone jar, taking care to cut the slices very thin; arrange them in alternate layers, shaking in as you proceed salt and cayenne in the above proportion; pour in the soy and wine, and fill up with vinegar. It will be fit for use the day it is made. Seasonable in August and September. Soy: This is a sauce frequently made use of for fish, and comes from Japan, where it is prepared from the seeds of a plant called Dolichos soja. The Chinese also manufacture it; but that made by the Japanese is said to be the best. All sorts of statements have been made respecting the very general adulteration of this article in England, and we fear that many of them are too true. When genuine, it is of an agreeable flavor, thick and of a clear brown color.

Pickled Gherkins.—Salt and water, 1 oz. of bruised ginger, ½ oz. of whole black pepper, ¼ oz. of whole allspice, 4 cloves, 2 blades of mace, a little horseradish. This proportion of pepper, spices, etc., for a quart of vinegar. Let the gherkins remain in salt and water for 3 or 4 days, then take them out, wipe perfectly dry, and put them into a stone jar. Boil sufficient vinegar to cover them, with spices and pepper, etc., in the above proportion, for 10 minutes; pour it quite boiling over the gherkins, cover the jar with vine leaves, and put over them a plate, setting them near the fire, where they must remain all night. Next day drain off the vinegar, boil it up again, and pour it hot over them. Cover up with fresh leaves, and let the whole remain till quite cold. Now tie down closely with bladder to exclude the air, and in a month or two they will be fit for use. Time: 4 days. Seasonable from the middle of July to the end of August. Gherkins are young cucumbers; and the only way in which they are used for cooking purposes is pickling them, as by the recipe here given. Not having arrived at maturity, they have not, of course, so strongly a developed flavor as cucumbers, and, as a pickle, they are very general favorites.

Indian Pickle.—To each gallon of vinegar allow 6 cloves of garlic, 12 shalots, 2 sticks of sliced horseradish, ¼ lb. of bruised ginger, 2 oz. of whole black pepper, 1 oz. of long pepper, 1 oz. of allspice, 12 cloves, ¼ oz. of cayenne, 2 oz. of mustard seed, ¼ lb. of mustard, 1 oz. of turmeric; a white cabbage, cauliflowers, radish pods, French beans, gherkins, small round pickling onions, nasturtiums, capsicums, chilies, etc. Cut the cabbage, which must be hard and white, into slices, and the cauliflowers into small branches; sprinkle salt over them in a large dish, and let them remain two days; then dry them and put them into a very large jar, with garlic, shalots, horseradish, ginger, pepper, allspice and cloves in the above proportions. Boil sufficient vinegar to cover them, which pour over, and when cold, cover up to keep them free from dust. As the other things for the pickle ripen at different times, they may be added as they are ready; these will be radish pods, French beans, gherkins,

small onions, nasturtiums, capsicums, chilies, etc. As these are procured, they must, first of all, be washed in a little cold vinegar, wiped, and then simply added to the other ingredients, in the large jar, only taking care that they are covered by the vinegar. If more vinegar should be wanted to add to the pickle, do not omit to boil it before adding it to the rest. When you have collected all the things you require, turn all out into a large pan, and thoroughly mix them. Now put the mixed vegetables into smaller jars, without any of the vinegar; then boil the vinegar again, adding as much more as will be required to fill the different jars, and also cayenne, mustard seed, turmeric and mustard, which must be well mixed with a little cold vinegar, allowing the quantities named above to each gallon of vinegar. Pour the vinegar, boiling hot, over the pickle, and, when cold, tie down with a bladder. If the pickle is wanted for immediate use, the vinegar should be boiled twice more, but the better way is to make it during one season for use during the next. It will keep for years, if care is taken that the vegetables are quite covered by the vinegar. This recipe was taken from the directions of a lady whose pickle was always pronounced excellent by all who tasted it, and who has, for many years, exactly followed the recipe given above.

Note.—For small families, perhaps, the above quantity of pickle will be considered too large; but this may be decreased at pleasure, taking care to properly proportion the various ingredients.

Pickled Nasturtiums.—(A very good substitute for capers.) To each pint of vinegar, 1 oz. of salt, 6 peppercorns, nasturtiums. Gather the nasturtium pods on a dry day, and wipe them clean with a cloth; put them in a dry glass bottle, with vinegar, salt and pepper, in the above proportion. If you cannot find enough ripe to fill a bottle, cork up what you have got until you have some more fit; they may be added from day to day. Bung up the bottles, and seal or rosin the tops. They will be fit for use in 10 or 12 months; and the best way is to make them one season for the next. Look for nasturtium pods from the end of July to the end of August.

Pickled Onions.—1 gal. of pickling onions, salt and water, milk; to each ½ gal. of vinegar, 1 oz. of bruised ginger, ¼ teaspoonful of cayenne, 1 oz. of allspice, 1 oz. of whole black pepper, ¼ oz. of whole nutmeg bruised, 8 cloves, ¼ oz. of mace. Gather the onions, which should not be too small, when they are quite dry and ripe; wipe off the dirt, but do not pare them; make a strong solution of salt and water, into which put the onions, and change this, morning and night, for three days, and save the last brine they are put in. Then take the outside skin off, and put them into a tin saucepan capable of holding them all, as they are always better done together. Now take equal quantities of milk and the last salt and water the onions were in, and pour this to them; to this add two large spoonfuls of salt, put them over the fire and watch them very attentively. Keep constantly turning the onions about with a wooden skimmer, those at the bottom to the top, and *vice versa*; and let the milk and water run through the holes of the skimmer. Remember, the onions must never boil, for if they do they will be good for nothing; and they should be quite transparent. Keep the onions stirred for a few minutes, and, in stirring them, be particular not to break them. Then have ready a pan with a colander, into which turn the onions to drain, covering them with a cloth to keep in the steam. Place on a table an old cloth two or three times double; put the onions on it when quite hot, and over them an old piece of blanket; cover this closely over them, to keep in the steam. Let them remain till the next day, when they will be quite cold and look yellow and shriveled; take off the shriveled skins, when they should be as white as snow. Put them in a pan, make a pickle of vinegar and the remaining ingredients, boil all these up, and pour hot over the onions in the pan. Cover very closely to keep in all the steam and let them stand till the following day, when they will be quite cold. Put them into jars or bottles, well bunged, and a tablespoonful of the best olive oil on the top of each jar or bottle. Tie them down with bladder, and let them stand in a cool place for a month or six weeks, when they will be fit for use. They should be beautifully white, and eat crisp without the least softness, and will keep good many months. Time: Five days. Seasonable from the middle of July to the end of August.

Pickling Onions.—To each quart of vinegar, 2 teaspoonfuls of allspice, 2 teaspoonfuls of whole black pepper. Have the onions gathered when quite dry and ripe, and, with the fingers, take off the thin outside skin; then with a silver knife (steel should not be used, as it spoils the color of the onions) remove one more skin, when the onion will look quite clear. Have ready some very dry bottles or jars, and as fast as they are peeled put them in. Pour over sufficient cold vinegar to cover them, with pepper and allspice in the above proportions, taking care that each jar has its share of the latter ingredients. Tie down with bladder and put them in a dry place, and in a fortnight they will be fit for use. This is a most simple recipe and very delicious, the onions being nice and crisp. They should be eaten within six or eight months after being done, as the onions are liable to become soft. Seasonable from the middle of July to the end of August.

Pickled Spanish Onions.—Onions, vinegar; salt and cayenne to taste. Cut the onions in thin slices; put a layer of them in the bottom of a jar; sprinkle with salt and cayenne; then add another layer of onions and season as before, proceeding in this manner till the jar is full. Pour in sufficient vinegar to cover the whole, and the pickle will be fit for use in a month. May be had in England from September to February.

Pickled Oysters.—One hundred oysters; to each ½ pint of vinegar, 1 blade of pounded mace, 1 strip of lemon peel, 12 black peppercorns. Get the oysters in good condition, open them, place them in a saucepan, and let them simmer in their own liquor for about ten minutes very gently; then take them out, one by one, and place them in a jar and cover them, when cold, with a pickle made as follows: Measure the oyster liquor; add to it the same quantity of vinegar, with mace, lemon peel and pepper in the above proportion and boil it for five minutes; when cold, pour over the oysters and tie them down very closely, as contact with the air spoils them. Seasonable from September to April.

Note.—Put this pickle away in small jars; because directly one is opened its contents should be immediately eaten, as they soon spoil. The pickle should not be kept more than two or three months.

Pickled Tomatoes and Onions.—One dozen of ripe tomatoes, their weight in onions, 1 qt. of vinegar, 1 teaspoonful of allspice, 2 oz. of black pepper. Choose ripe tomatoes, and wipe them dry; take off the skin of the onions and put, with the other ingredients, in a stew-pan, where let them gently simmer for eight hours. When cold, bottle and tie over with bladder. Time: Eight hours. This pickle should be made in autumn.

Universal Pickle.—To 6 qt. of vinegar allow 1 lb. of salt, ¼ lb. of ginger, 1 oz. of mace, ½ lb of shalots, 1 tablespoonful of cayenne, 2 oz. of mustard-seed, 1½ oz. of turmeric. Boil all the ingredients together for about twenty minutes; when cold, put them into a jar with whatever vegetables you choose, such as radish pods, French beans, cauliflowers, gherkins, etc., as these come into season; put them in fresh as you gather them, having previously wiped them perfectly free from moisture and grit. This pickle will be fit for use in about eight or nine months. Time: Twenty minutes. Make the pickle in May or June, to be ready for the various vegetables. As this pickle takes two or three months to make—that is to say, nearly that time will elapse before all the different vegetables are added—care must be taken to keep the jar which contains the pickle well covered, either with a closely-fitting lid, or a piece of bladder securely tied over, so as perfectly to exclude the air.

Pickled Walnuts.—One hundred walnuts, salt and water. To each quart of vinegar allow 2 oz. of whole black pepper, 1 oz. of allspice, 1 oz. of bruised ginger. Procure the walnuts while young; be careful they are not woody, and prick them well with a fork; prepare a strong brine of salt and water (4 pounds of salt to each gallon of water), into which put the walnuts, letting them remain nine days, and changing the brine every third day; drain them off, put them on a dish, place it in the sun until they become perfectly black, which will be in two or three days; have ready dry jars, into which place the walnuts, and do not quite fill the jars. Boil sufficient vinegar to cover them, for ten minutes, with spices in the above proportion, and pour it hot over the walnuts, which must be quite covered with the pickle, tie down with bladder and keep in a dry place. They will be fit for use in a month.—*Mrs. Beeton.*

Sauces.—A Good Table Sauce.—The following formula, if properly prepared, will make an elegant table sauce: Allspice, 2 parts; cloves, 1 part; black pepper, 1 part; ginger, 1 part; cayenne, 1 part; mustard (English), 16 parts; salt, 16 parts; shalots, 16 parts; brown sugar, 32-64 parts; tamarinds, 32 parts; curry powder (East Indian), 8 parts; California sherry, 120 parts; garlic, at discretion, q. s.; best malt or cider vinegar, q. s. to make 500 parts.

Sauce Aristocratique.—Green walnuts. To every pint of juice, 1 lb. of anchovies, 1 drm. of cloves, 1 drm. of mace, 1 drm. of Jamaica ginger bruised, 8 shalots. To every pint of the boiled liquor, ½ pt. of vinegar, ¼ pt. of port, 2 tablespoonfuls of soy. Pound the walnuts in a mortar, squeeze out the juice through a strainer, and let it stand to settle. Pour off the clear juice, and to every pint of it add anchovies, spice and cloves in the above proportion. Boil all these together till the anchovies are dissolved, then strain the juice again, put in the shalots (8 to every pint), and boil again. To every pint of the boiled liquor add vinegar, wine and soy, in the above quantities, and bottle off for use. Cork well and seal the corks. Make this sauce from the beginning to the middle of July, when walnuts are in perfection for sauces and pickling.

Carrack Sauce (for Cold Meat).—1 qt. of vinegar, 15 anchovies, 3 dessertspoonfuls of mango pickle, 8 dessertspoonfuls of walnut pickle, 5 dessertspoonfuls of mushroom catsup, 5 dessertspoonfuls of soy, 2 heads of garlic. Chop and slice the ingredients, then put all into a bottle and set it in a dry, warm place. Shake it regularly every day for a month when it will be ready to use. The mango pickle may be omitted.

Bengal Recipe for Making Mango Chutney.—1½ lb. of moist sugar, ¾ lb. of salt, ¼ lb. of garlic, ¼ lb. of onions, ¾ lb. powdered ginger, ¼ lb. of dried chilies, ¾ lb. of mustard seed, ¾ lb. of stoned raisins, 2 bottles of best vinegar, 30 large unripe sour apples. The sugar must be made into syrup; the garlic, onions, and ginger be finely pounded in a mortar; the mustard seed be washed in cold vinegar, and dried in the sun; the apples be peeled, cored, and sliced and boiled in a bottle and a half of the vinegar. When all this is done, and the apples are quite cold, put them into a large pan, and gradually mix the whole of the rest of the ingredients, including the remaining half bottle of vinegar. It must be well stirred until the whole is thoroughly blended, and then put into bottles for use. Tie a piece of wet bladder over the mouths of the bottles, after they are well corked. This chutney is very superior to any which can be bought, and one trial will prove it to be delicious.

Note.—This recipe was given by a native to

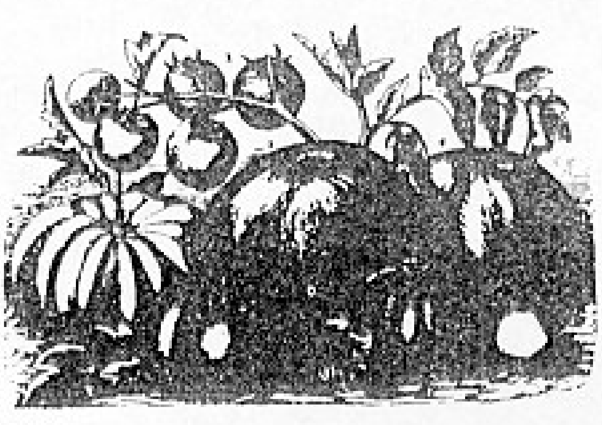
an English lady who had long been a resident in India, and who, since her return to her native country, has become quite celebrated among her friends for the excellence of this Eastern relish.

Indian Chutney Sauce.—8 oz. of sharp, sour apples, pared and cored, 8 oz. of tomatoes, 8 oz. of salt, 8 oz. of brown sugar, 8 oz. of stoned raisins, 4 oz. of cayenne, 4 oz. of powdered ginger, 2 oz. of garlic, 2 oz. of shalots, 3 qt. of vinegar, 1 qt. lemon juice. Chop the apples in small square pieces, and add to them the other ingredients. Mix the whole well together, and put in a well-covered jar. Keep this in a warm place, and stir every day for a month, taking care to put on the lid after this operation; strain, but do not squeeze it dry; store it away in clean jars or bottles for use, and the liquor will serve as an excellent sauce for meat or fish. Make this sauce when tomatoes are in full season, that is, from the beginning of September to the end of October.

Store Sauce or Cherokee.—One-half oz. of cayenne pepper, 5 cloves of garlic, 2 tablespoonfuls of soy, 1 tablespoonful of walnut catsup, 1 pt. of vinegar. Boil all the ingredients gently for about half an hour; strain the liquor and bottle off for use. Time: One-half hour. Seasonable. This sauce can be made at any time.

Harvey Sauce.—One dozen of anchovies, 6 dessert-spoonfuls of soy, ditto of good walnut pickle, 3 heads of garlic, 2 shalots, 1 oz. of cayenne pepper, ¼ oz. of cochineal, 1 gal. of vinegar. Cut the anchovies small, but do not remove the bones. Chop the pickles, shalots and garlic; then put all the ingredients into a deep jar and let it stand fourteen days, stirring it well two or three times every day. Then strain through a jelly-bag till it is quite clear, bottle it and tie bladders over the corks.

Sauce of Herbs.—(For bottling.) One stick of horseradish, 2 shalots, 1 sprig each of winter savory, basilicum, marjoram and thyme, a



little tarragon, 4 cloves, juice of 1 lemon, 1 wineglassful of vinegar, 1 pt. of water, 1 teaspoonful of browning. Wash and scrape the horseradish, strip the sprigs of their leaves, slice the shalots thinly, and put all into a saucepan with the vinegar, lemon juice and water. Put in the browning, and as soon as the mixture boils, simmer very gently for fifteen minutes; then strain, and when quite cold put up in small bottles. This sauce is an excellent addition to gravies, or may be used in their stead. Time: About ½ hour. Seasonable at any time.

Sauce à la Militaire.—(Good with all kinds of meat, game, fish.) Six shalots, 1 clove of garlic, a handful each of thyme, basil, tarragon leaves, ½ oz. of bruised mustard seed, 2 laurel leaves, ¼ oz. of mace, ditto of cloves, ½ oz. of long pepper, 2 oz. of salt, 6 dessert-spoonfuls of very strong vinegar, juice of 1 lemon, 1 teaspoonful of grated Seville orange peel, ½ pt. of white wine. Shred the shalots and split the garlic; then put all the ingredients into an earthen jar, cover very closely, and put into an oven or on a hot hearth to infuse. Allow it to settle; then strain till quite clear; then bottle and cork closely. A small quantity only is required with the viands. Time: Two to three hours. Seasonable at any time.

Leamington Sauce.—Walnuts. To each quart of walnut juice allow 3 qt. of vinegar, 1 pt. of Indian soy, 1 oz. of cayenne, 2 oz. of shalots, ¾ oz. of garlic, ½ pt. of port. Be very particular in choosing the walnuts as soon as they appear in the market, for they are more easily bruised before they become hard and shelled. Pound them in a mortar to a pulp, strew some salt over them and let them remain thus for two or three days, occasionally stirring and moving them about. Press out the juice, and to each quart of walnut liquor allow the above proportion of vinegar, soy, cayenne, shalots, garlic, and port. Pound each ingredient separately in a mortar, then mix them well together, and store away for use in small bottles. The corks should be well sealed. This sauce should be made as soon as walnuts are obtainable, from the beginning to the middle of July.

Reading Sauce.—2½ pt. of walnut pickle, 1½ oz. of shalots, 1 qt. of spring water, ¾ pt. of Indian soy, ½ oz. of bruised ginger, ½ oz. of long pepper, 1 oz. of mustard seed, 1 anchovy, ½ oz. of cayenne, ½ oz. of dried sweet bay leaves. Bruise the shalots in a mortar, and put them in a stone jar with the walnut liquor; place it before the fire, and let it boil until reduced to 2 pt. Then into another jar put all the ingredients except the bay leaves, taking care that they are well bruised, so that the flavor may be thoroughly extracted; put this also before the fire, and let it boil for 1 hour, or rather more. When the contents of both jars are sufficiently cooked, mix them together, stirring them well as you mix them, and submit them to a slow boiling for half an hour; cover closely, and let them stand for 24 hours in a cool place; then open the jar and add the bay leaves; let it stand a week longer, closed down, when strain through a flannel bag, and it will be ready for use. The above quantities will make ½ gal. Time.—Altogether, 3 hours. Seasonable. This sauce may be made at any time.

Tomato Sauce.—1 doz. tomatoes, 2 teaspoonfuls of the best powdered ginger, 1 dessertspoonful of salt, 1 head of garlic chopped fine, 2 tablespoonfuls of vinegar, 1 dessertspoonful of chili vinegar (a small quantity of cayenne may be substituted for this). Choose ripe tomatoes, put them into a stone jar and stand

them in a cool oven until quite tender; when cold, take the skins and stalks from them, mix the pulp with the liquor which is in the jar, but do not strain it; add the other ingredients, mix well together, and put it into well-sealed bottles. Stored away in a cool dry place, it will keep good for years. It is ready for use as soon as made, but the flavor is better after a week or two. Should it not appear to keep, turn it out, and boil it up with a little additional ginger and cayenne. For immediate use, the skins should be put into a wide-mouthed bottle with a little of the different ingredients, and they will be found very nice for hashes or stews. Time.—4 or 5 hours in a cool oven. Seasonable from the middle of September to the end of October.

Tomato Sauce for Keeping.—3 doz. tomatoes; to every pound of tomato pulp allow 1 pt. of chili vinegar, 1 oz. of garlic, 1 oz. of shalot, 2 oz. of salt, 1 large green capsicum, ½ teaspoonful of cayenne, 2 pickled gherkins, 6 pickled onions, 1 pt. of common vinegar, and the juice of 6 lemons. Choose the tomatoes when quite ripe and red; put them in a jar with a cover to it, and bake them till tender. The better way is to put them in the oven overnight, when it will not be too hot, and examine them in the morning to see if they are tender. Do not allow them to remain in the oven long enough to break them; but they should be sufficiently soft to skin nicely and rub through the sieve. Measure the pulp, and to each pound of pulp add the above proportion of vinegar and other ingredients, taking care to chop very fine the garlic, shalot, capsicum, onion, and gherkins. Boil the whole together till everything is tender; then again rub it through a sieve, and add the lemon juice. Now boil the whole again till it becomes as thick as cream, and keep continually stirring; bottle it when quite cold, cork it well, and seal the corks. If the flavor of garlic and shalot is very much disliked, diminish the quantities. Time.—Bake the tomatoes in a cool oven all night. Seasonable from the middle of September to the end of October. A quantity of liquor will flow from the tomatoes, which must be put through the sieve with the rest. Keep it well stirred while on the fire, and use a wooden spoon.

Tomato Chow-chow.—Take 6 large ripe tomatoes, 1 large onion, 1 green pepper, 1 tablespoonful of salt, 2 of brown sugar, 2 teacupfuls of vinegar. Peel and cut fine the tomatoes, chop fine the onion and pepper, add the salt, sugar, and vinegar. Stew gently for 1 hour. Make this in September.

Mustards.—French Mustard.—Mustard, whole mixed spice, 3 lumps of sugar, vinegar. Boil the spices and sugar in some of the vinegar; take some good mustard and mix it into a stiff paste with cold vinegar. With a red hot iron heater, or other suitable piece of iron, stir quickly while you mix in the boiling vinegar, after straining it from the spices; put into wide-mouthed bottles. Will keep for years if kept well corked. Seasonable at any time.

Note.—A substitute for French mustard may be had by making 2 qt. of vinegar hot and pouring it over 6 oz. of salt, ¼ lb. of scraped horseradish, ¼ oz. of sugar and half a clove of garlic. This should stand for twenty-four hours before it is strained and bottled.

Prepared Table Mustard.—1. Ordinary Mustard.—Stir gradually 1 pt. of good white wine into 8 oz. of ground mustard seed and a pinch of pulverized cloves, and let the whole boil over a moderate coal fire. Then add a small lump of white sugar, and let the mixture boil up once more.

2. Pour ½ pt. of boiling white vinegar over 8 oz. of ground mustard seed in an earthen pot, stir the mixture thoroughly, then add some cold vinegar, and let the pot stand overnight in a warm place. The next morning add ½ lb. of sugar, ¾ drm. of pulverized cinnamon, ½ drm. of pulverized cloves, 1¼ drm. of Jamaica pepper, some cardamom, nutmeg, half the rind of a lemon, and the necessary quantity of vinegar. The mustard is now ready, and is kept in pots tied up with bladder.

3. Mix 8 lb. of ground mustard seed with 1½ pt. of good, cold vinegar, heat the mixture over a moderate fire for 1 hour, add 1 drm. of ground Jamaica pepper, and when cold keep it in well closed jars.

4. Frankfort Mustard.—Mix 1 lb. of white mustard seed, ground, a like quantity of brown mustard seed, 8 oz. of pulverized loaf sugar, 1 oz. of pulverized cloves, 2 oz. of allspice, and compound the mixture with white wine or wine vinegar.

5. Lenormand's Mustard.—Mix with 2 lb. of ground mustard seed, ½ oz. each of fresh parsley and tarragon, both cut up fine, 1 clove of garlic also cut up very fine, and 12 salted anchovies; grind the mixture very fine, add the required mustard and 1 oz. of pulverized salt, and for further grinding dilute with water. To evaporate the water after grinding the mustard, heat an iron rod red hot, and cool it off in the mixture, and then add wine vinegar of the best quality.

6. Very Fine Table Mustard.—Digest 1¾ oz. of fresh tarragon leaves, 2 bay leaves, 1 lemon (juice and rind), ¼ drm. each of cloves and cinnamon, ¾ drm. of black pepper, ¾ oz. of dill, and 1 onion in ½ gal. of good vinegar. It is best to use a steam apparatus for the purpose. Then strain the fluid into a porcelain vessel, and, while it is yet warm, mix with it 1 lb. of ground black mustard seed, a like quantity of white mustard, 1 lb. of sugar and 3½ oz. of common salt. Let the whole digest, stirring frequently, until the mustard has lost some of its sharpness by the evaporation of the ethereal oil, and then dilute, according to taste, with more or less vinegar.

7. Fresh Mustard.—The following mixture is to be mixed with good wine vinegar, or, better yet, a vinegar in which have been macerated some celery root, garlic, onion and chives: Colman's mustard, 900 parts; sugar, 100 parts; salt, 100 parts; pepper, 50 parts; cinnamon, 25 parts; cardamom, 10 parts; and ginger, 15 parts.

A Good Mustard (Soyer).—Mustard seed, 1 part, weak wood vinegar, 2 parts. Pour the vinegar on the mustard seed and let them soak for a fortnight; then grind the whole into a paste in a mill and put it into pots, then thrust a red-hot poker into each of the pots. Seasonable at any time.

Indian Mustard.—¼ lb. of best mustard, ¼ lb. of flour, ½ oz. of salt, 4 shalots, 4 tablespoonfuls of vinegar, 4 tablespoonfuls of catsup, ¼ bottle of anchovy sauce. Put the mustard, flour, and salt into a basin, and make them into a stiff paste with boiling water. Boil the shalots with the vinegar, catsup, and anchovy sauce, for 10 minutes, and pour the whole, boiling, over the mixture in the basin; stir well, and reduce it to proper thickness; put it into a bottle, with a bruised shalot at the bottom, and store away for use. This makes an excellent relish, and if properly prepared will keep for years.

Ravigotte Mustard.—Parsley, 2 parts; chervil, 2 parts; chives, 2 parts; cloves, 1 part; garlic, 1 part; thyme, 1 part; tarragon, 1 part; salt, 8 parts; olive oil, 4 parts; white wine vinegar, 128 parts; mustard flour, sufficient.

Cut or bruise the plants and spices, and macerate them in the vinegar for fifteen or twenty days. Strain the liquid through a cloth and add the salt. Rub up mustard with the olive oil in a vessel set in ice, adding a little of the spiced vinegar from time to time until the whole is incorporated and the complete mixture makes 384 parts.

Catsups.—Camp Catsup.—2 qt. of strong old beer, 1 qt. of white wine, ¼ lb. of anchovies, 3 oz. of peeled shalots, ½ oz. of grated nutmeg, ditto mace, ditto sliced ginger. Put the ingredients on the fire in a saucepan, and stir them till they are reduced one-third. Bottle next day with the spice and shalots. About 1¼ hours.

Grape Catsup.—5 lb. of ripe grapes, 2½ lb. of sugar, 1 pt. of vinegar, 1 teaspoonful each of cinnamon, cloves, allspice, and pepper, ½ teaspoonful of salt. Boil the grapes in enough water to prevent burning, strain through a colander, add the other ingredients, and boil until a little thickened. Bottle, and cork and seal. Make this from August to October.

Mustapha or Liver Catsup.—1 beef liver, 1 gal. of water, 1 oz. of ginger, 1 oz. of allspice, 2 oz. of whole black pepper, 2 lb. of salt. Roll the salt, and well rub it into a very fresh beef liver, and place it in a vessel that will not crush it. Turn and rub it thoroughly for 10 days. Then mince it into small dice, and boil in a gallon of water, closely covered, until reduced to 3 qt. Then strain through a sieve, and let it settle till next day. Add the pepper, allspice, and ginger, and boil slowly until further reduced to 3 pt. When cold, bottle and keep well corked. Time.—12 days. Seasonable at any time.

Mushroom Catsup.—To each peck of mushrooms ½ lb. of salt; to each quart of mushroom liquor ¼ oz. of cayenne, ½ oz. of allspice, ½ oz. of ginger, 2 blades of pounded mace. Choose full grown mushroom-flaps, and take care they are perfectly fresh-gathered when the weather is tolerably dry; for, if they are picked during very heavy rain, the catsup from which they are made is liable to get musty and will not keep long. Put a layer of them in a deep pan, sprinkle salt over them, and then another layer of mushrooms, and so on alternately. Let them remain for a few hours, when break them up; put them in a nice cool place for three days, occasionally stirring and mashing them well, to extract from them as much juice as possible. Now measure the quantity of liquor without straining, and to each quart allow the above proportion of spices, etc. Put all into a stone jar, cover it up very closely, put it in a saucepan of boiling water, set it over the fire, and let it boil for three hours. Have ready a nice clean stewpan; turn into it the contents of the jar, and let the whole simmer very gently for half an hour; pour it into a jug, where it should stand in a cool place till the next day; then pour it off into another jug, and strain it into very dry clean bottles, and do not squeeze the mushrooms. To each pint of catsup add a few drops of brandy. Be careful not to shake the contents, but leave all the sediment behind in the jug; cork well, and either seal or rosin the cork, so as perfectly to exclude the air. When a very clear, bright catsup is wanted, the liquor must be strained through a very fine hair-sieve or flannel bag, after it has been very gently poured off; if the operation is not successful, it must be repeated until you have quite a clear liquor. It should be examined occasionally, and if it is spoiling, should be reboiled with a few peppercorns. Seasonable from the beginning of September to the middle of October, when this catsup should be made.

Oyster Catsup.—Sufficient oysters to fill a pint measure, 1 pt. of sherry, 3 oz. of salt, 1 drm. of cayenne, 2 drm. of pounded mace. Procure the oysters very fresh, and open sufficient to fill a pint measure; save the liquor, and scald the oysters in it with the sherry; strain the oysters, and put them in a mortar with the salt, cayenne and mace; pound the whole until reduced to a pulp, then add it to the liquor in which they were scalded; boil it again five minutes, and skim well; rub the whole through a sieve, and, when cold, bottle and cork closely. The corks should be sealed. Seasonable from September to April. Cider may be substituted for the sherry.

Pontac Catsup or Sauce.—Ripe elderberries, vinegar, cloves, mace, peppercorns, shalots, anchovies. Take ripe elderberries, as many as you wish to store, pick them from their stalks into a stone jar and just cover with strong, good vinegar. Bake in a hot oven for three hours, then strain while hot. Boil the liquor thus obtained with the spices and shalots, sufficient being put in to give a considerable flavor. Taste the mixture, and, when found sufficiently flavored, put half a pound of the best anchovies to every quart of the liquor; then stir and boil till these are dissolved, and move at once from the fire. Put up in pint bottles, cork closely and tie bladders over the top. Time: From

3 to 4 hours. Prepare this in September.

Tomato Catsup.—Spices of various kinds are employed for this purpose, as the following formula shows:

1. Ripe tomatoes.......... ....6 qt.

Bruise and set in an oven with 1⅛ lb. of salt and a quart of water. At the end of an hour pour off a gallon of juice, and to this add shalots, peeled and sliced, 4 oz., black pepper, bruised, ⅛ oz.; mace, bruised, ⅛ oz.; pimento, bruised, ⅛ oz.; ginger, bruised, ⅛ oz.; nutmeg, bruised, ⅛ oz.; cochineal, in coarse powder, 2 drm.; cayenne pepper, in coarse powder, 1 drm.; brown vinegar, 1 pt. Simmer gently for half an hour, strain and bottle.

2. Ripe tomatoes, 3 doz.; chili vinegar, 1 pt.; garlic, 1 oz.; shalots, 1 oz.; common salt, 2 oz.; cayenne pepper, ½ drm.; lemon juice, 5 oz. Put the tomatoes into a jar and warm in an oven until tender. Cool, skin, and pulp the fruit, and add to the liquor in the jar, along with the rest of the ingredients. Mix well and bottle.

Walnut Catsup.—Half sieve of walnut shells, 2 qt. of water, salt, ½ lb. of shalots, 1 oz. of cloves, 1 oz. of mace, 1 oz. of whole pepper, 1 oz. garlic. Put the walnut shells into a pan, with the water and a large quantity of salt; let them stand for 10 days, then break the shells up in the water, and let it drain through a sieve, putting a heavy weight on the top to express the juice; place it on the fire, and remove all scum that may arise. Now boil the liquor with the shalots, cloves, mace, pepper and garlic, and let all simmer till the shalots sink; then put the liquor into a pan, and, when cold, bottle and cork closely. It should stand 6 months before using; should it ferment during that time, it must be again boiled and skimmed. Time: About ¾ hour. Seasonable in September, when the walnut shells are obtainable.

Vinegar.—Camp Vinegar.—1 head of garlic, ½ oz. of cayenne, 2 teaspoonfuls of soy, 2 teaspoonfuls of walnut catsup, 1 pt. of vinegar, cochineal to color. Slice the garlic, and put it, with all the above ingredients, into a clean bottle. Let it stand to infuse for a month, then strain it off quite clear, and it will be fit for use. Keep it in small bottles, well sealed to exclude the air.

Cress Vinegar.—½ oz. of cress seed, 1 qt. of vinegar. Bruise the seed in a mortar, and put it into the vinegar, previously boiled and allowed to grow cold. Let it infuse for a fortnight, then strain and bottle for use.

Cucumber Vinegar.—10 large cucumbers, or 12 smaller ones, 1 qt. of vinegar, 2 onions, 2 shalots, 1 tablespoonful of salt, 2 tablespoonfuls of pepper, ¼ teaspoonful of cayenne. Pare and slice the cucumbers, put them into a stone jar or wide-mouthed bottle with the vinegar; slice the onions and shalots, and add them, with all the other ingredients, to the cucumbers. Let it stand 4 or 5 days, boil it all up, and, when cold, strain the liquor through a piece of muslin, and store it away in small bottles well sealed. This vinegar is a very nice addition to gravies, hashes, etc., as well as a great improvement to salads; or to eat with cold meat.

Garlic Vinegar.—2 oz. of garlic, 1 qt. of wine vinegar. Chop the garlic finely and weigh it, then put it in the above proportion to the cold boiled vinegar. Infuse for a fortnight, strain and bottle.

Horseradish Vinegar.—¼ lb. of scraped horseradish, 1 oz. of minced shalot, 1 drm. of cayenne, 1 qt. of vinegar. Put all the ingredients into a bottle, which shake well every day for a fortnight. When it is thoroughly steeped, strain and bottle, and it will be fit for use immediately. This will be found an agreeable relish to cold beef, etc. This vinegar should be made either in October or November, as horseradish is then in its highest perfection.

Mint Vinegar.—Vinegar, mint. Procure some nice fresh mint, pick the leaves from the stalks, and fill a bottle or jar with them. Add vinegar to them until the bottle is full, cover closely to exclude the air, and let it infuse for a fortnight. Then strain the liquor, and put it into small bottles for use, of which the corks should be sealed. This should be made in June, July or August.

Shalot Vinegar.—2 oz. of shalots, 1 qt. of wine vinegar. Prepare precisely as directed for garlic vinegar. Make this in October.

Indian Curry Powder.—¼ lb. of coriander seed, ¼ lb. of turmeric, 2 oz. of cinnamon seed, ½ oz. of cayenne, 1 oz. of mustard, 1 oz. of ground ginger, ½ oz. of allspice, 2 oz. of fenugreek seed. Put all the ingredients in a cool oven, where they should remain one night; then pound them in a mortar, rub them through a sieve, and mix thoroughly together; keep the powder in a bottle, from which the air should be completely excluded.

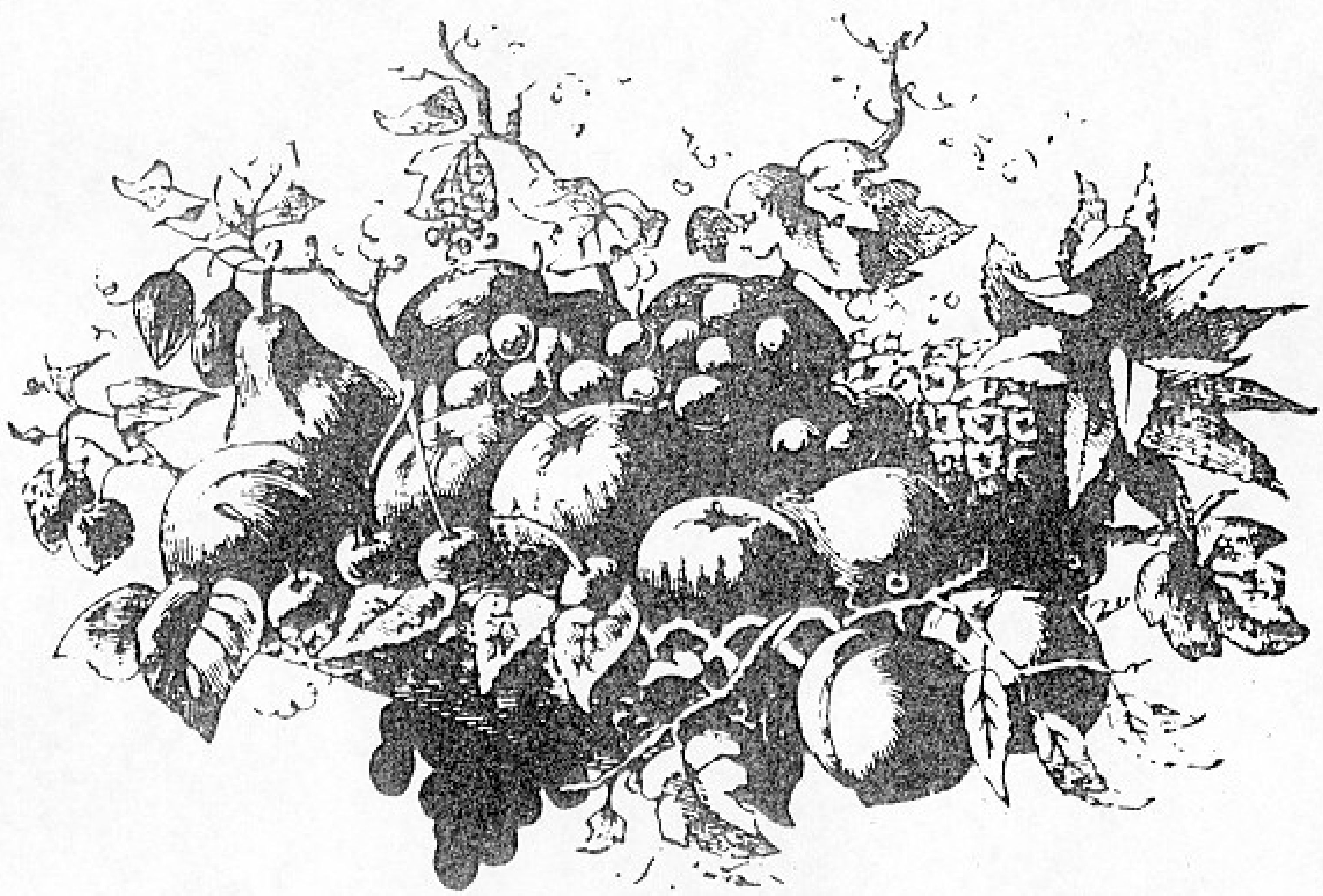
To Dry Herbs for Winter Use.—On a very dry day gather the herbs, just before they begin to flower. If this is done when the weather is damp, the herbs will not be so good a color. (It is very necessary to be particular in little matters like this, for trifles constitute perfection, and herbs nicely dried will be found very acceptable when frost and snow are on the ground. It is hardly necessary, however, to state that the flavor and fragrance of fresh herbs are incomparably finer.) They should be perfectly freed from dirt and dust and be divided into small bunches, with their roots cut off. Dry them quickly in a very hot oven, or before the fire, as by this means most of their flavor will be preserved; be careful not to burn them; tie them up in paper bags, and keep in a dry place. This is a very general way of preserving dried herbs; but we would recommend the plan described in the next recipe. From the month of July to the end of September is the proper time for storing herbs for winter use.

Herb Powder for Flavoring.—1 oz. of dried lemon-thyme, 1 oz. of dried winter savory, 1 oz. of dried sweet marjoram and basil, 2 oz. of dried parsley, 1 oz. of dried lemon peel. Pre-

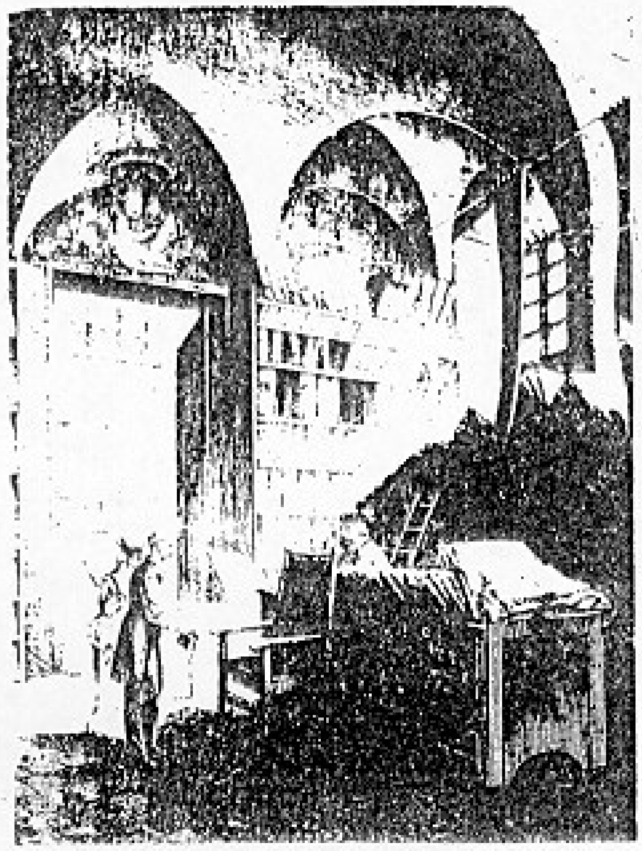
pare and dry the herbs by recipe above; pick the leaves from the stalks, pound them, and sift them through a hair-sieve; mix in the above proportions, and keep in glass bottles, carefully excluding the air. This we think a far better method of keeping herbs, as the flavor and fragrance do not evaporate so much as when they are merely put in paper bags. Preparing them in this way, you have them ready for use at a moment's notice. Mint, sage, parsley, etc., dried, pounded, and each put into separate bottles, will be found very useful in winter.

Mushroom Powder.—½ peck of large mushrooms, 2 onions, 12 cloves, ¼ oz. of pounded mace, 2 teaspoonfuls of white pepper. Peel the mushrooms, wipe them perfectly free from grit and dirt, remove the black fur, and reject all those that are at all worm-eaten; put them into a stewpan with the above ingredients, but without water; shake them over a clear fire till all the liquor is dried up, and be careful not to let them burn; arrange them on tins and then dry them in a slow oven; pound them to a fine powder, which put into small, dry bottles; cork well, seal the corks, and keep it in a dry place. In using this powder, add it to the gravy just before serving, when it will merely require one boil-up. The flavor imparted by this means to the gravy ought to be exceedingly good. This should be made in September or at the beginning of October.

Note.- If the bottles in which it is stored away are not perfectly dry, as also the mushroom powder, it will keep good but a very short time.



From the Archives



These are science excerpts from Harper's New monthly Magazine from 1869 through 1874. They are comparable to the little scientific inserts sprinkled throughout such modern magazines as Popular Science. These excerpts are interesting and many are applicable to crafts and trades today. Others are merely thought-provoking; but where might those provoked thought lead?

Other Archives sections are in Vol. 1.

USE OF SLATE IN RELIEF ENGRAVING.

Blocks of slate, of suitable size, are recommended as a substitute for box-wood for engraving in relief. It is claimed that while these blocks are very easily cut, they will furnish a hundred thousand good impressions without wearing. They are not affected by oil nor water, do not vary with the temperature, and never become warped, which is so serious a fault with box-wood in certain instances.

ARSENIC IN MENTAL DISEASES.

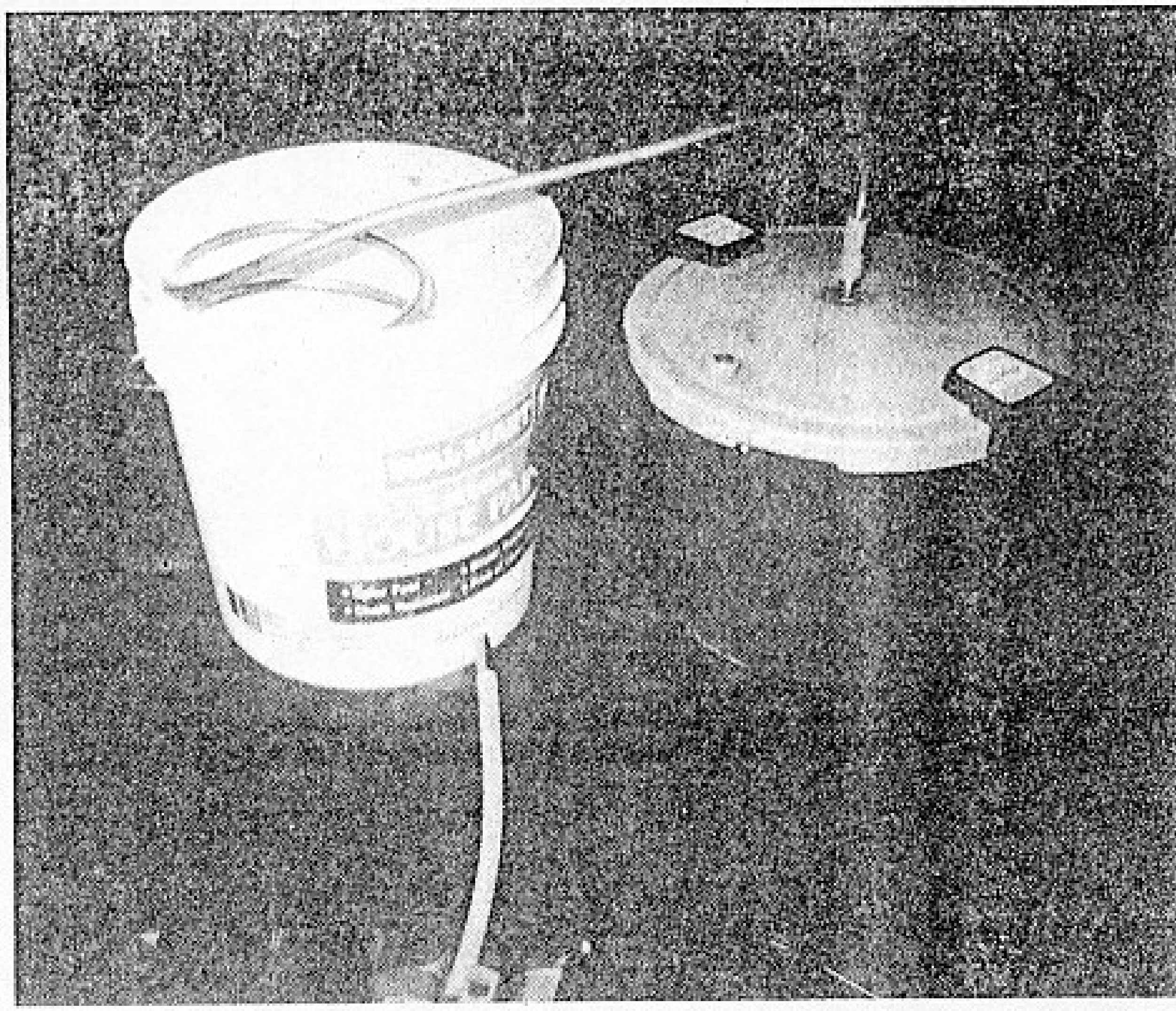
It is asserted that arsenious acid, or the common arsenic of commerce, when properly administered, has a marked effect upon cases of mental derangement, and one author even estimates that about sixty-six per cent. of all cases may be cured by this agent.

GAMGEE'S PROCESS OF PREPARING MEAT.

Among the many methods suggested, of late years, for preparing fresh meat in such a way as to admit of its being carried long distances to market, so that it may be furnished at a moderate rate, that of Professor Gamgee promises to be one of the most successful. This gentleman, an eminent veterinary surgeon, and at the head of the Veterinary College of London, visited the

THE ART OF MAKING ALCOHOL

by Kurt Saxon



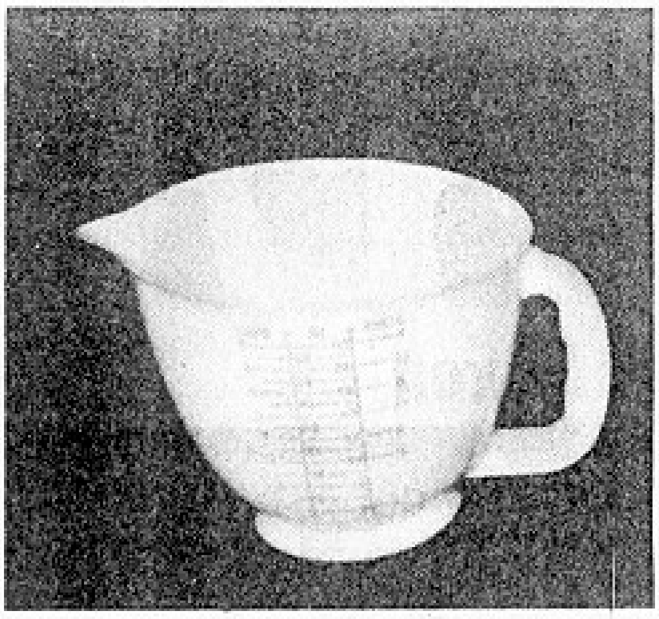
I had intended to write an article telling you how to make about a quart of 90 proof alcohol for less than a dollar.

So I gathered up all the books I had concerning alcohol and set out to master the process on a small scale. My Emporium of Arts and Sciences of 1814 told of whisky production in Lancaster County, PA. In a year, from 611 stills, 3,295,500 gallons, or 5,394 gallons per still, or an average of 14.77 gallons per still per day was produced. Going by the low level of technology in 1814 the process had to be pretty simple. And it is.

Whiskey. In Lancaster county, Pennsylvania, during a year ending with April 1814, six hundred and eleven stills, manufactured 3,295,500 gallons of whiskey.

But try finding that simple process in a modern book. Most of the books on the subject are frauds. No beginner could learn how to make ethyl alcohol from any of them.

Take "The Moonshiner's Manual", by a man calling himself Michael Barleycorn, copyright 1975. The book is entertaining, cleverly illustrated, but filled with misinformation and nonsense. I'll criticize it, but only to



TWO QUART PLASTIC
MEASURING PITCHER

United States last year, for the purpose of prosecuting experiments on his new method in Texas; and it may be recollected that while here he rendered good service to American agriculture by his investigations of certain diseases of cattle—the Spanish fever especially—and by a report made by him to the Agricultural Department at Washington. It was in Texas that his special investigations in regard to the preservation of meat were prosecuted, as the abundance of cattle, worth there little more than the value of their hides, rendered it possible for him to conduct his experiments on a large scale; and it is understood that the exportation of fresh meat from that State to Europe and to the northern United States, will be prosecuted vigorously in the future.

In Professor Gamgee's process, the living animal is first caused to inhale carbonic oxide, placed in a bag and held over the nose, the gas being prepared by the action of sulphuric acid upon oxalic acid. The application of the gas, of course, produces asphyxia, and the animal falls to the ground, after which it is bled and dressed in the usual manner. Brine of the proper strength is next injected into the meat by hydrostatic pressure, or otherwise; and it is then placed, after being cut up, in an air-tight apartment, from which the air is first exhausted: more air is afterward admitted, which has first passed through red-hot charcoal, so as to convert the oxygen into carbonic acid and carbonic oxide. In this way all the oxygen is removed from the chamber, after which an atmosphere of sulphurous acid is introduced and is absorbed by the meat, which is soon completely saturated with it. The meat is allowed to remain from five to twenty days in this atmosphere, when it may be taken out, and it will then keep perfectly fresh, tasting when cooked precisely like newly-killed meat. There are other details of the process which we do not reproduce, our object being simply to illustrate the principle by which it is made to answer its desired end.

MONSTER INDUCTION APPARATUS.

The monster induction apparatus of the Polytechnic Institution of London, under the direction of Professor Pepper, continues to excite much attention among those who have had an opportunity of witnessing its remarkable effects. This instrument is nearly ten feet in length, and two feet in diameter; the primary copper wire, 3770 yards in length, surrounds the iron nucleus with 6000 turns, and the secondary wire is 150

show you why you can't depend on such books to live up to their claims.

When you buy a book telling you how to do something illegal, to complain that it is inaccurate is almost an admission that you're up to no good. The publisher banks on that. That's why shady outfits like Delta, Paladin and Butokukai keep cranking out garbage to sell to suckers. Books with sensational titles and seductive ad copy, but with nothing of value between the covers.

Getting back to "The Moonshiner's Manual", it says to put 25 pounds of cracked corn in a gunny sack and soak it in a tub of warm water for three days! It suggests that natural fermentation will come into play. What you would get in that three days would be 25 pounds of, not fermented, but rotted corn. Then you are supposed to put the corn, sack and all, into the vat with 30 pounds of pure cane sugar and 1-2 quarts of molasses.

In a later, scaled down recipe, he calls for 2 1/2 to 5 pounds of cracked corn, in a small sack, 5 to 10 pounds of sugar and 1 pint of molasses or 1 cup of unflavored malt.

The corn, sack and all, is to be put into the fermenting vat. Insane! The part about the gunny sack is an old technique for sprouting the corn.

Sprouting, or malting, turns most of the starch into sugars and diastase. The sugars are readily converted into alcohol by yeast and the diastase acts on the remaining starch to turn it into dextrine, also quickly acted on by the yeast.

The gunny sack is filled with whole, non-hybrid corn, not cracked. The sack is immersed in a tub of warm water and left for 24 hours, then drained. Then it is flooded with warm water once every 24 hours until it expands and bursts. These are sprouts. Plenty of dextrine and diastase. No cane sugar is needed. To throw the sack into the fermenting vat would be stupid.

The sprouted grain is then pulverized and put in the fermenting vat. Water and yeast are added and the fermentation proceeds apace

Both recipes call for molasses, which is unnecessary.

It should be obvious that Michael wrote the book to sell to suckers and had no real knowledge of moonshining.

He goes into great detail about the penalties attached to moonshining. This has a purpose and is a paradox at the same time. First, he's scaring the average reader out of any notion of making his own booze. This keeps most from trying the techniques, finding them useless and demanding refunds. The paradox arises in the fact that

miles long. The galvanic current of the primary wire is furnished by a Bunsen battery of forty cells. This apparatus gives sparks, or, rather, lightning shocks, of twenty-nine inches in length, and apparently three-fourths of an inch in thickness, which strike the disk with deafening force. They penetrate a glass of five inches in thickness, in a zigzag direction, and with a perforation one-fiftieth of an inch in diameter; although, the glass being marked all around with radial *lines*, the fracture seems broader than it actually is.

As a producer of common electricity, this apparatus exceeded all expectation. A Leyden battery of forty square feet was charged in a very short time, and the discharge of this battery burned a considerable length of iron wire with perfect ease.

SALTS OF COPPER A PRESERVATIVE AGAINST MOULD.

The application of salts of copper to stones exposed to the atmosphere (the sulphate, or blue vitriol, especially) is strongly recommended, for the purpose of preventing the growth of cryptogamic plants, which so frequently injure them. Housekeepers, who are distressed by the formation of a green coating upon the brick pavements in damp yards and shady places, may perhaps find in this hint a suggestion of a method of preventing the difficulty in question. It is probable that crude carbolic acid will have the same, but perhaps a less durable, effect.

FIRE-PROOF CLOTHING.

The number of casualties resulting from the accidental ignition of cotton clothing has induced the Chief of Police of Berlin to make an official communication to the public, urging the employment of certain substances which have recently been found to have a very satisfactory effect in rendering such articles non-combustible.

The preparation recommended consists of a mixture of about 25 parts of tungstate of soda, and three or four parts of phosphate of soda, dissolved in 100 parts of water. If the articles are such as require to be starched, they may be afterward immersed in this solution, and then dried and ironed; or a small portion of the combined salts may be introduced into the starch before it is applied to the clothing. Articles which are not to be starched may be simply dipped in the solution, and then dried and ironed. The immunity from burning of articles prepared in this way is very great, so much so as entirely to remove any apprehension of danger to children whose clothing has been thus treated.

RENDERING FABRICS WATER-PROOF.

Some general statements have been made respecting a method lately devised for rendering tissues water-proof by subjecting them to the action of sulphuric acid; and we now give the process in greater detail, so as to permit the experiment to be tried more satisfactorily. For the purpose in question, sulphuric acid of 40° to 60°, of Baumé's hydrometer, is to be used, about 67° being the proper strength for linen. Into this the fabric is to be dipped and kept for from ten seconds to two minutes, according to the material, and then immediately well washed in fresh running water, so as to arrest the decomposition begun by the acid. After repeated washings the article is to be dried, and the surface will be found coated with a sort of continuous layer, which fills up the interstices between the warp and the woof, and at the same time strengthens the fabric and converts it into a kind of parchment tissue, this increase in strength in the case

no one could use these instructions for making alcohol, thus, the warnings are unnecessary.

Another book, and a good one, is "Solargas", by David Hoye, 1979. This is about fuel. Hoye goes to great lengths to make sure the smallest batch is poisoned by denatured alcohol, lest a sip pass the lip.

Only one page tells of making alcohol from ground, unsprouted corn. All other references are to sprouted corn.

There are two bars to making booze by following this book. The first is the constant harping on getting Federal permission and filling out all those forms. This intimidates. The second is that you can no longer buy non-hybrid corn at your local feed and seed store. It is all hybrid and only about 10% will sprout, leaving 90% a rotten mess. You have to buy it from a farmer who grows non-hybrid corn or grow it yourself.

I didn't know this until I began researching. I meant to use Hoye's book to make alcohol and then tell you how. I processed two pounds of corn and was surprised to see that only one out of ten grains sprouted. The rest rotted. Rotted starch doesn't convert to alcohol.

There are several alcohol for fuel books on the market. Most of them are inaccurate and therefore fraudulent. Even the best were published with doubtful sincerity. I'm sure their publishers realized that nine out of ten buyers of the books had no intention of converting their vehicles to alcohol. Consider; you can modify your vehicle's engine to run on alcohol, propane, methane, diesel etc. Then, when you're on the road and run out of fuel you don't just turn into the nearest gas station, turn a knob on your engine and reconvert to gasoline. No. If you convert, you're stuck with it until you convert back.

Moreover, aside from all the forms and bureaucracy with the Feds, converting, even for farm vehicles, isn't cost-effective. And if you intend to go commercial, you face a starting cost of maybe a hundred thousand dollars, not to mention bucking the competition.

So, I repeat my contention that the average guy who buys a book on making alcohol wants to save on his liquor bills. With what you are going to learn here, you will never need to buy booze again, much less another silly book on making it.

But before we go into that, let me explain the law. You can distill alcohol if you pay the liquor tax on it. So if you don't pay the liquor tax, with all the red tape that involves, the bottom line is that you are guilty of tax evasion.

Sure, they can jail you, take everything you have, put

of linen amounting to about one-third. It is recommended to pass the tissue, as soon as it is taken from the bath, through rollers, so as to spread the sticky layer and render it uniform.

A modification of the experiment consists in applying a solution of wood, cotton, linen, etc., in sulphuric acid of 59° Baumé to any fabric by means of rollers or brushes.

PRESERVATION OF GRAIN AND SEED IN VACUO.

Some time since Dr. Louvel, of France, proposed the use of vacuum reservoirs for the permanent and definite preservation of seeds and grain of all kinds. Further experiments have been made in this direction, and it seems to be pretty well ascertained that the process has an economical value; and that while the necessary vessels can be made of large size at a moderate cost, the process of exhaustion of the air also costs but little; and once treated in this way the seeds can remain an indefinite number of years without further attention, with a certainty that all the elements, chemical or vital, of the grain will be properly preserved.

CHLORAL.

The subject of chloral still continues to occupy the attention of physiologists; and this substance seems destined to render as important service in medicine as chloroform does in surgery. Conflicting accounts have been published of its effects upon the system; but from a recent report to the Academy of Sciences in Paris, we are assured that these results are caused entirely by a difference in the degree of purity of the article used; and that where the pure hydrate is employed, no substance known in medicine is more regular and definite in its effects.

One test of excellence consists in the addition of a concentrated solution of potash; if the chloral be pure the solution will become of a pale faint yellow color, with the disengagement of an agreeable odor of chloroform. If, however, a brown color is produced, with chloro-acetic vapors, or any others, mixed with those of chloroform, the sample is to be rejected.

It is said that the dose should not exceed five grammes (about seventy-seven grains) for an adult, and one or two fifths of this amount for an infant. It may be administered either by the mouth, or by external application to the skin, which will produce the same effect as when taken into the stomach. Its administration by hypodermic injection is considered dangerous. The arterial tension is increased under the influence of slumber produced by chloral, the frequency of the pulsations becoming lessened, and diminished after awakening.

The action of chloral is similar to that of chloroform; but it takes longer to produce its effect, which, however, is more prolonged. The general result is to produce slumber, rarely accompanied by hyperæsthesia; and, in a great majority of cases, remarkable for a very decided anæsthesia, which with the doses above mentioned, according to age, is sufficiently complete to allow of the extraction of teeth, or other operations.

As a therapeutic, the hydrate of chloral is said to operate as a sedative in violent attacks of the gout, of the pains of acute or nephritic colic, of decayed teeth, etc.; in a word, it is to be looked upon as the first of the anæsthetics administered internally. It has been used with great success in cases of intense chorea, and other nervous affections, where the rapid motions of the patient tended to produce serious effects.

It has been remarked that chloral is one of the many substances the discovery of which we owe to the theoretical chemist, like chloroform, hav-

your wife on the street, sell your kids. I'm not really kidding!

But so what? If you're making your own, how can anyone know what you do when you're alone?

Even so, let's say the Feds wanted to harass you. They have to prosecute, in these days of overcrowded jails and backed-up court dockets. Then they have to prove to a jury that your still was for making alcohol, instead of for purifying water as is done in hundreds of thousands of homes, with stills bought mainly from Sears.

Or maybe you admit you made the still but it's a lab still for ever so many uses, even for purifying water. Unless they catch you in the act of distilling alcohol, how could they prove it to a jury?

Many people have asked me if it is advisable to carry a concealed weapon. I ask them if they have ever been searched by the police. The answer has always been no.

So I ask what makes a person think he will be searched after he begins to carry a concealed weapon?

The same goes for distilling. Even so, I am not encouraging you to break the stupid law. You shouldn't

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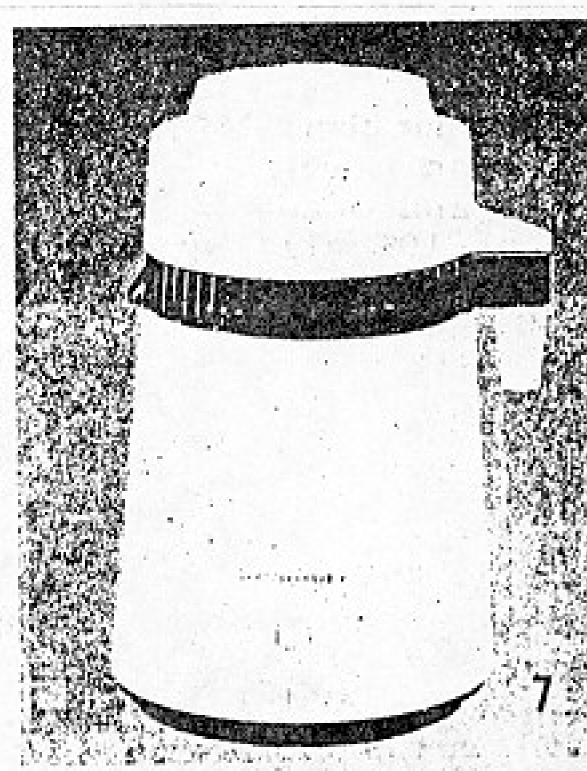

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even drink. But when this system unravels a bit more, you will have a trade which will insure your survival. The techniques I'll show you in this and following articles will enable you to make beer, wine, whiskey, etc. It's easy.

The equipment won't be expensive, either. It can

ing been the subject of critical investigation in the laboratory without any therapeutic virtues being suspected in either for some considerable time after their discovery.

ENLARGED GOOSE LIVERS.

Enlarged goose livers, so much used in the preparation of pâtés and other culinary delicacies, are usually obtained, it is asserted, by nailing the feet of living geese upon a board, and keeping them in a dark place, near a hot fire, and stuffing them with rich food. A less cruel method of accomplishing the same object is said to consist in feeding garlic and Indian corn in equal quantities every day. In one instance it is stated that the liver of a goose fed in this manner for some time weighed as much as thirty ounces.

POISONOUS STOVES.

THE approach of cold weather calls out a renewed warning from the French sanitarians of the danger of heating stoves red-hot, especially those made of cast iron. It has been found that cast iron, under such circumstances, is permeable to the gases of combustion, particularly to carbonic oxyd, and that the simplest tests prove the existence of this highly poisonous gas in the immediate vicinity of the stove; and, where the ventilation is insufficient, throughout the atmosphere of the room.

Sheet-iron has been found less objectionable, except when red-hot; in which case, as well as that of very hot cast iron, there appeared to be a decomposition of the carbonic acid thrown into the atmosphere by respiration, and a transformation into carbonic oxyd. It is supposed also that the oxygen of the atmosphere combines, to a certain extent, with the carbon of the iron, so as to increase the percentage of carbonic oxyd. The evil effect of the presence of this gas, and others scarcely less objectionable which pass readily through the heated iron, is shown in various ways, apart from that of actual asphyxia or suffocation, several cases of severe fevers, especially in badly-ventilated rooms, having been traced directly to this cause.

The primary remedy against this evil result is to have the stove lined internally with brick or some substance other than cast iron, and to have the upper part made of sheet-iron, so that the gases may not pass through the cylinder of the stove, but be carried off directly into the chimney. If, however, a cast-iron cylinder is necessary, then it should be completely encircled by sheet-iron, with an air-chamber between, and some arrangement by which the air in that space may be passed into the flue, and not escape into the room.

SUBSTITUTE FOR SUMAC.

A substitute for sumac in tanning has recently been discovered in an American plant, known as *Spiræa tomentosa*, or meadow-sweet, and which has been found to be so rich in tannin as to possess a very great economical value. The plant is extremely abundant in many parts of the country, growing in damp meadows, where it can be gathered in large quantities in a wild state, and it could be easily cultivated so as to produce a supply for this purpose.

HAY-FEVER.

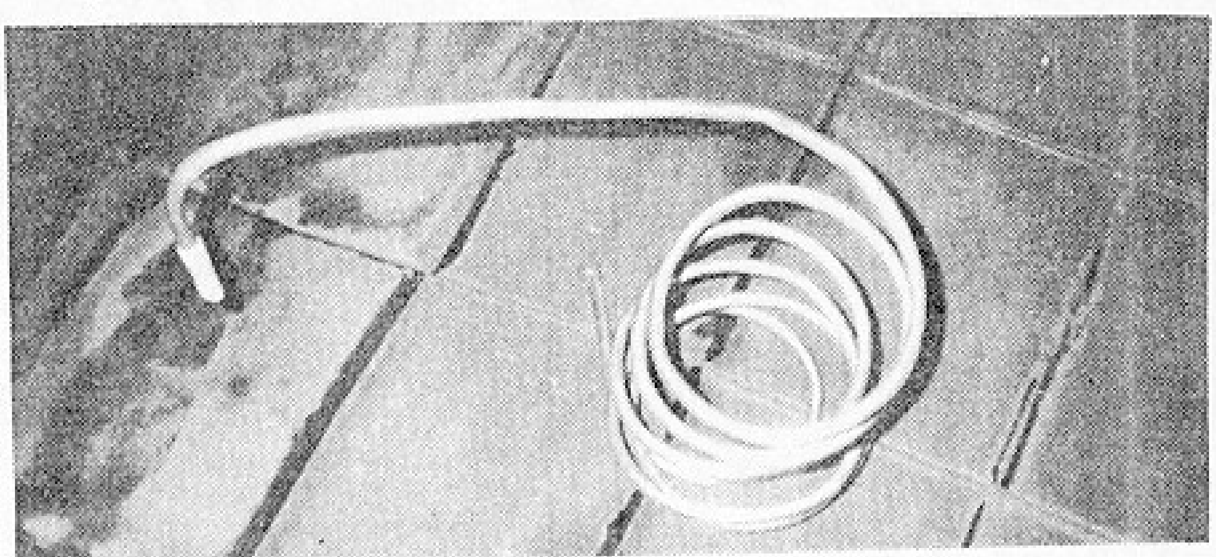
Few of our readers are without some experience, either in themselves or through their friends, of the distressing affection known as "hay-fever," or "rose-cold," a kind of catarrh which appears, year after year, in the same person at about the same period of the summer season. An eminent microscopist, troubled with this complaint, has recently announced his belief that it is caused by

consist of a food dryer like mine, a Corona grain mill and a pressure cooker (unless you have a Kenmore water purifier from Sears). You will also need ten feet of 3/8 inch copper tubing, bought at most hardware stores for 50 cents a foot. The rest is just odds and ends you may have or can get at little cost.

I'm not going to write everything in this article because I don't have room and it would be too much to absorb at this time. Instead, I'll show you how to make the still and how to run off a quart of very high-proof alcohol.

It would be best for you to get a Kenmore Water Purifier from Sears. Otherwise, get a pressure cooker of at least one gallon capacity. That's the pot for the still. Mine is a teflon-coated Presto Chicken Fryer of a one gallon capacity. I don't know how much it cost new as I got it for a couple of dollars a a garage sale. You may have to get one new but make sure it's coated as alcohol reacts with aluminum.

You need a pressure cooker. Otherwise the alcohol will go out into the air if you just use any old cook pot, no



matter how close-fitting the lid. Also, it takes a little pressure to force the fumes through, especially if the coil isn't completely slanted and pressure is needed to push the liquid alcohol through.

Next get 10 feet of copper tubing. Copper is better than plastic or rubber. It causes no bad taste. Also, it gives up heat into the cool water better than plastic or rubber and will last a lifetime.

Next get a two gallon plastic paint bucket or similar. Drill a 3/8 inch hole near the bottom of the bucket.

Now for bending the coil. You do it an inch at a time and it is pretty tedious. It takes a few minutes to get the hang of it but then you'll be moving right along.

First, bend one end downward to connect with the pressure cooker vent. You'll not get the copper tubing over the vent so you will need about two inches of 3/8 inch latex

the development, at the season indicated, of vibrios, a peculiar form of low organic life well known to microscopists. They appeared to him to be developed in the cavities and recesses connected with the nose, although not in the nose itself, since its ordinary secretion did not contain them, and they were only found when a violent sneezing, or blowing of the nose, took place. If this be the fact, it is quite probable that the true cure for the disease is to be found in the snuffing up of the vapor of carbolic acid; this substance having the property of destroying the vitality of microscopic growths, and preventing their multiplication.

SPECTROSCOPIC EXAMINATION OF FIRE-FLY'S LIGHT.

Since the discovery of the spectroscope its powers have been tested in the analysis of light of many kinds, whether distant or near; and, as our readers may know, some of the most important discoveries in regard to the constitution of the heavenly bodies have been made by this means. Professor Young has recently used it in examining the light of the common fire-fly; and reports that the spectrum is perfectly continuous, without traces of lines either bright or dark, and extends from a little above Fraunhofer's line C in the scarlet to about F in the blue, gradually fading out at the extremities. Professor Young remarks that it is just this portion of the spectrum that is composed of rays, which, while they may affect the organs of vision more powerfully than any others, have very little heating power, showing that the entire energy of the animal is expended in producing light, and that none is wasted in heat. This, he says, is very different from artificial modes of illumination, such as the flame of burning gas, which is so constituted that not more than one or two per cent. of the radiant energy consists of visible rays, the remainder being wasted in producing rays that do not give out light.

IS ANIMAL LIFE ALWAYS DEPENDENT ON PLANTS?

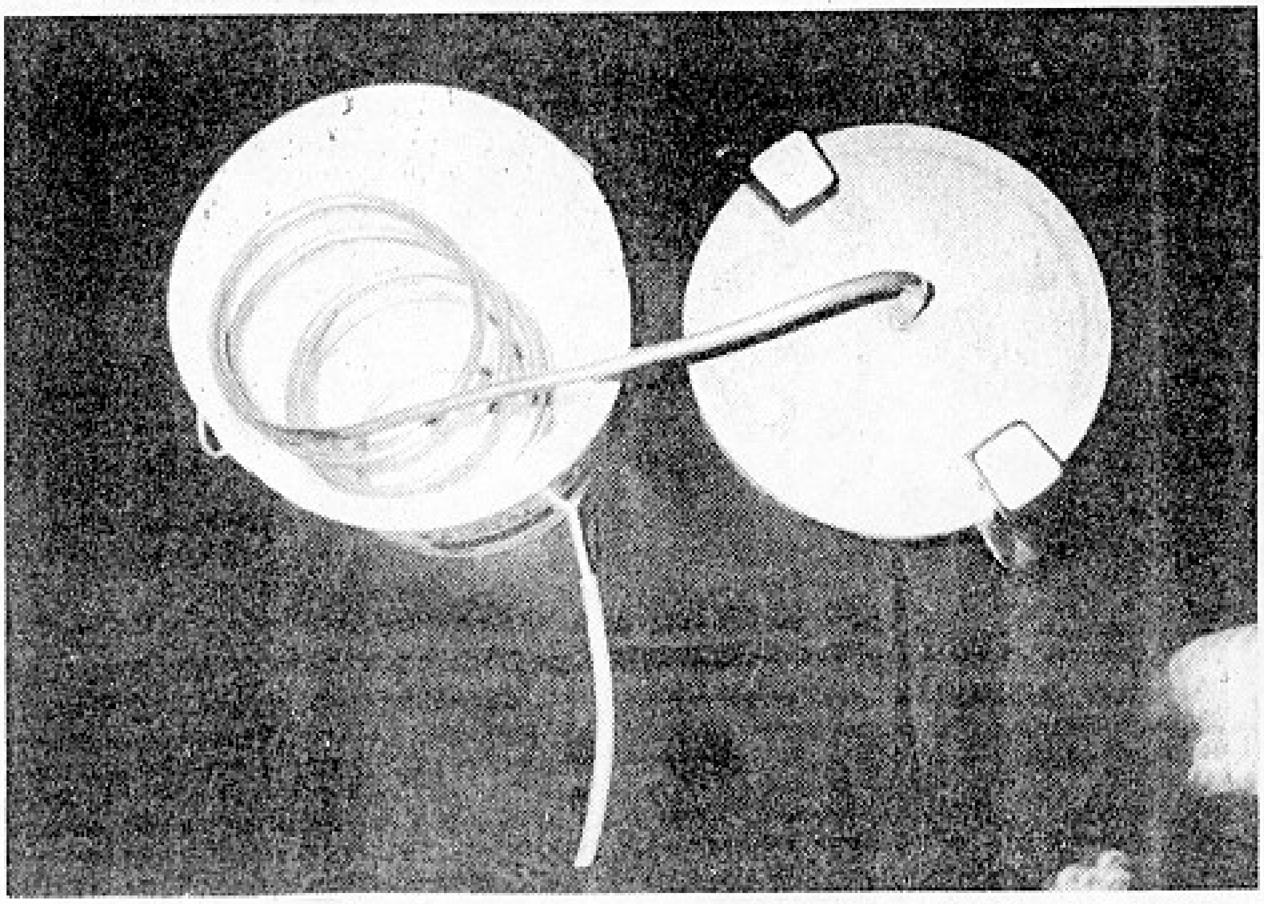
It has been asserted by many naturalists that plants necessarily form the basis of animal life; since species that do not live on vegetable matter devour those that do. Mr. Gwyn Jeffreys, however, calls attention to the fact that plant life appears to be totally absent in the ocean, with the exception of a comparatively narrow fringe (as the littoral and laminarian zones) which borders the coasts of the ocean, and the Sargasso seas, or fields of living, floating sea-weed, found in mid-ocean. During the recent explorations on the steamer *Porcupine*, already adverted to, he could not detect the slightest trace of vegetable matter at a greater depth than fifteen fathoms. Animal organisms of all kinds, living and dead, were found every where from the surface to the bottom, and were invariably those that subsisted on flesh, there being none that depend upon plants. But as all animals are said to exhale carbonic acid gas, and give out the same by their decomposition, he inquires whence the oceanic animals get that supply of carbon which those living among plants derive directly from them; and asks whether any class of marine animals can assimilate the carbon contained in the sea, just as plants do that contained in the air. Without himself attempting to solve the problem, he presents it for the consideration of his brother naturalists, remarking, however, that the theory referred to above, of the dependence of animals upon vegetables, does not seem to apply to those inhabiting the main ocean.

tubing, bought at any pharmacy for about 60 cents a foot.

When you have the downward bend done, without crimping it, go over about 14 inches and start on the coil itself.

Keep bending so you have circles about six inches across. It shouldn't crimp if you bend it gently an inch at a time. But if it does start to crimp, just use a pair of pliers on each side of the crimp to pressure it back.

When you have five or six circles, shove the end through the hole in the bucket. Next use some GOOP to seal it inside and out. GOOP can be bought at any good hardware store. It is a plastic sealant, quite thick and takes a couple of hours to set and about 24 hours to really harden.



It has a tendency to sag and that's good. For the inside of the bucket, squeeze a large dollop on a pencil and stick it down to the tubing in the hole. Work it around and under and it will sag evenly and flow around the tube and rest on the bottom of the bucket.

Then take the tube of GOOP and squeeze some around the outside tubing. After a few minutes it will sag and, with the pencil, pull up the sag and place it back around the tube and it will begin to harden. A day later it will be hard and your condenser will be water-tight forever.

If the end of the tube protrudes only a couple of inches from the condenser and that's not enough to reach over the stove to flow into the container, you can attach a few inches of latex tubing to it so it will be long enough.

Now you want to find the proper temperature for distilling. Put a gallon of water in the pot and set it to

MONTEVIDEAN BEEF.

Beef is now offered for sale in London and Paris at from five to eight cents a pound, prepared in Montevideo, from the native cattle of that country, by the process of Mr. Gorges. This consists in soaking the meat, in pieces of from five to one hundred pounds, in a mixture of water (85 per cent.) and hydrochloric acid, glycerine, and hyposulphite of soda (15 per cent.). After a time the pieces are removed and dusted over with finely powdered bisulphite of soda, and then packed in boxes as full as possible and sealed up air-tight. In this way the meat will keep for any length of time; and it is rendered fit for use by simply soaking for a few minutes in water to which a little vinegar has been added, followed by a moderate exposure to the air. It is claimed that the meat thus prepared is equal to that of a recently killed animal.

IMITATING DARK WOODS.

The appearance of walnut may be given to white woods by painting or sponging them with a concentrated warm solution of permanganate of potassa. The effect is different on different kinds of timber, some becoming stained very rapidly, others requiring more time for this result. The permanganate is decomposed by the woody fibre; brown peroxyd of manganese is precipitated, which is afterward removed by washing with water. The wood, when dry, may be varnished, and will be found to resemble very closely the naturally dark woods.

CARBOLIC ACID AND CHOLERA.

A Paris journal contains a letter from a correspondent in Nicaragua, detailing the effect of the use of carbolic acid as a preventive of disease during the cholera epidemic in that country. The superintendent of an extensive plantation, employing several hundred persons, took the precaution to water the corridors and interior of the buildings every day with a solution of the acid, and had the pleasure of finding, as the result, that not a single member of his establishment died of the disease, although many fatal cases were constantly occurring in the neighborhood. An additional advantage was the disappearance of intermittent fever, as well as of fleas, bugs, and other vermin. It was also used with entire success in driving away ants, which are so troublesome as neighbors in tropical countries.

ALUMINUM BRONZE.

Workers in metal do not seem to become weary in their praises of the virtues of aluminum bronze, especially when composed of ten per cent. of aluminum and ninety per cent. of copper. Its color resembles eighteen-carat gold, and it is capable of receiving a polish far superior in beauty to that of any gilding. This ten per cent. bronze may be forged like iron or steel, either cold or hot, and becomes very compact under the action of the hammer. It can be rolled into sheets, or drawn into wire or tubes of any diameter. Its specific gravity is about that of iron. It is acted upon by atmospheric influences less than any metal or alloy, except gold, platinum, and aluminum. It is tougher than iron, very stiff and elastic; and, in short, possesses a vast category of attributes of the highest value.

It is now much used for watch movements, as well as for articles for the table—such as spoons, forks, cups, etc.

VEGETABLE ORIGIN OF SCARLET-FEVER.

A recent writer expresses the opinion that scarlet-fever is the product of a fungus of the genus *Tilletia*; and he also states that this disease is

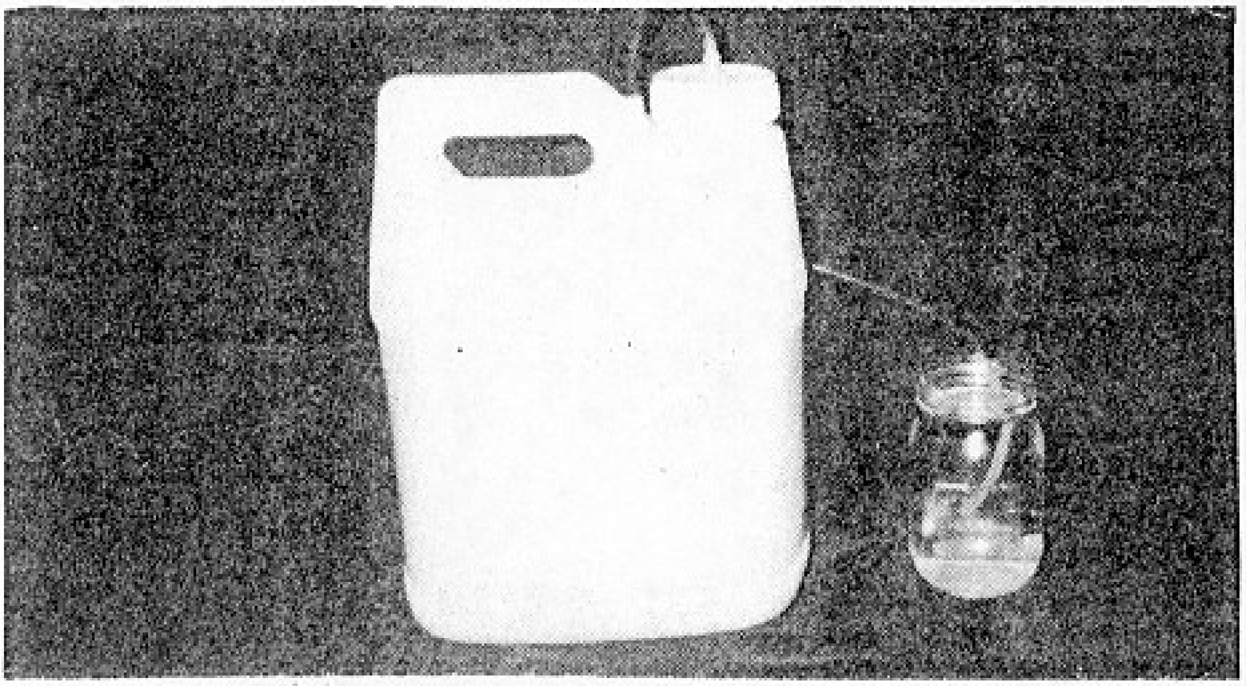
boiling. Then turn down the heat to a rolling boil and mark the setting on the stove or hot plate so you can just set it in place from then on.

Alcohol boils at 173 degrees F and water boils at 212. The rolling boil is slightly lower but much hotter than needed to vaporize alcohol. But that's alright. So some water will come over. But the alcohol will flow with the higher temperature. When the alcohol is out the flow will stop and be replaced by a trickle which will be water and the distilling will be finished.

To test the system, and so you can do something right away, buy a gallon of cheap wine with an alcohol content of 10-13%. When I was a bum I would pour a gallon of $3.00 Burgundy into my still and put a quart jar under the spout. When the flow of alcohol turned to a trickle of water, sure enough, I would have a quart of about 90 proof alcohol. It added up to at least $11.00 worth of hard liquor for only $3.00.

I would cut that with juice or whatever and have enough to party with my friends or have several glorious drunks. You can't get that crocked on 13% volume wine.

If you have made your own still, you need to cool the condenser so the alcohol will liquefy. If you are using a hot plate to heat the pot, you can situate the still by the sink. With another hole drilled near the bottom of the bucket and another tube coming from the cold faucet, the warm water would be constantly replaced by cold as the water left the



bucket by another tube into the sink.

But that is an awful waste of water and would show up on your utility bill. You could use ice cubes, which is quite a job. My way was to freeze cans of water. I would put several average cans of ice in the bucket and fill it with water. As they melted I would just transfer a can of water

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especially characterized by the existence of an immense number of micrococci in the blood, which are at first as small as the finest pin point, and occur in greater numbers than the blood globules themselves. They seem to accumulate about these globules, and to penetrate into their substance, producing a complete disorganization.

FREEZING MIXTURES.

An elaborate course of experiments has recently been made in Germany, with a view of determining the comparative amount of reduction of temperature caused by dissolving different salts in water. The most remarkable result was found in the use of sulpho-cyanide of potassium, a solution of which in water reduced the temperature in a few minutes from fifty degrees above to ten degrees below zero, or a depression of sixty degrees.

THE CHEMICAL FIRE-EXTINGUISHER.

Recent improvements of a form of apparatus known under this name have rendered it an important auxiliary in the prevention of fires, and one well worthy of being kept in all public buildings, as well as private establishments, which are not absolutely fire-proof.

It consists simply of a cylinder, of about the size of a common water-cooler, which, when filled, can be carried about by means of a strap passing over the shoulders. The liquid employed is a solution of bicarbonate of soda, and tartaric acid in crystals is placed in a perforated tube screwed into the top of the cylinder and dipping down into the liquid. The contact of the acid and alkali, of course, generates carbonic acid gas, which rises to the top, and is ready for use, and can be drawn off through a pipe whenever required. A moderate current of this gas turned upon a burning surface will extinguish it almost immediately, no matter how intense the flame may be, or how inflammable the substance in combustion. In one instance a mass of dry light wood, composed of barrels, split-wood, and shavings saturated with petroleum, equal in quantity to several cords, was set on fire, and allowed to burn for some time. Two of the extinguishers were then brought to bear upon it, and the flames were subdued instantly.

The gas does not deteriorate by being kept, but remains ready for use an indefinite period of time.

It may be stated, in this connection, that not many months ago a fire broke out in the fine building of the Boston Society of Natural History; but the services of an extinguisher were called into play, and the flames were instantly subdued under circumstances that rendered it probable that without this application the entire building might have been destroyed.

PREPARATION OF OIL-PAINT.

Among the many improvements in the practical arts that have been announced within later years few are perhaps more striking than the new process of preparing oil-paints, by which the old-fashioned machinery is entirely dispensed with, and a better result obtained in a much shorter time, with the least possible expense. This process, first discovered in France, is now carried on there, as well as in Germany, on a large scale, in both public and private establishments; but we have not heard whether it has yet been introduced in the United States. The new method consists simply in mixing any of the ordinary materials for painting, such as lampblack, white-lead, red-lead, or oxyd of zinc, with water, so as to form a thick paste. This, while still diluted, is passed through fine sieves so as to remove all foreign or hard particles. It is then

back to the freezing compartment of my fridge and replace it with another ice can.

If you have a setup by a stream, you would have a faucet at the bottom of the condenser. With the faucet open you would replace the warm water with buckets of cold from the stream.

Now to the making of basic moonshine. For this you will need at least one cat-litter container. These are the perfect size for a batch of mash. They are sold in every supermarket for about $5.00. If you have cats, you may already have some or may get them from friends. Barring that, it is worth the price for the container.

These containers hold about 2 1/2 gallons. A batch of mash is 1 gallon and 3 quarts, so there is plenty of room. You can also watch what's happening.

First you drill a quarter-inch hole in the cap and push a half-inch of two feet of quarter-inch plastic tubing through and GOOP it on both sides. This is an ingenious way of knowing when the yeast has stopped working and the alcohol content is as high as it is going to go. You put the end of the tube into a jar of water and the carbon dioxide from the working yeast comes up through the water in the jar. When the bubbles stop coming, or slow to a burp every two minuets, it is ready. This also keeps your working mash odor-free.

Next, you finely grind two pounds of corn, sprouted to about a half inch, in your Corona grain mill. Then get a cook pot holding over two gallons. They are relatively cheap at Wal-Mart and can be gotten for a couple of dollars from most second-hand stores. Avoid aluminum. Use stainless steel or enamel.

Pour in two gallons of hot tap water and then bring it to a brisk boil. Then dribble in the ground corn meal, stirring all the while so it doesn't lump.

Cooking the mash serves two purposes. First, it breaks down the starch granules so the yeast can more effectively work on them. Second, it kills any bacteria which might otherwise spoil the mash.

After thirty or forty minutes, take the pot off the heat and put it in a dishpan of cold water to cool it down. It shouldn't have any lumps in it since that would cause uneven fermentation. If you have stirred it properly, there should not be any lumps. In case there are, break them up with any hand mixer.

Now for the yeast-sugar mix. Weigh out 1/2 pound of sugar and put it in a measuring pitcher. Then add hot water until it reaches the quart mark. The sugar should

placed in a vat or tub, and a quantity of drying oil poured into it, and stirred continually for a considerable time, during which the paints form an apparently chemical union with the oil, and leave the water. A pasty mass soon makes its appearance, which falls to the bottom and is removed; and this is afterward treated much like fresh butter in the operation for removing the buttermilk, until the water is separated, leaving a prepared paint, which may be diluted with oil or turpentine as desired, and is then ready for use.

By this process a single workman has been known to prepare 250 pounds of the best oil-paint in two hours with simply a tub, two or three sieves, and a wooden spatula.

Lampblack requires a slightly different manipulation from that used for the other substances mentioned, as it must first be moistened with a small quantity of water containing about ten per cent. of alcohol or whisky. It is then to be stirred until the mixture has the appearance of fresh snuff, in which condition it is to be mixed with water, passed through a sieve, and treated as already stated.

IMPROVEMENT OF GYPSUM CASTS.

Persons who have occasion to take casts in gypsum, for purposes of science or art, may be pleased to learn of a method by which the appearance of ivory and of bone may be imparted to them. For this purpose the casts are to be exposed in a stove for forty-eight hours, at a temperature of from about 250 to 350 degrees, Fahr., and then allowed to stand in the air for three or four hours, and finally immersed in hot white varnish, olive-oil, melted fat, wax, or stearin, until their surface is completely saturated. After this they are to be dipped for a moment in water heated to 100 to 120 degrees; and this operation repeated every quarter of an hour for several hours; after which they are to be left in the water until the desired degree of hardness is attained.

DEVELOPMENT OF SILK-WORM EGGS.

An announcement has lately been made to the Academy of Sciences in Paris which, if verified by further experiments, promises to be of much importance in the rearing of silk-worms. M. Duclaux, the author of the communication, states that exposure to a considerable degree of cold for a time is absolutely necessary for the formation of the embryo in the egg, and that so long as the egg is kept in a warm room it will fail to attain its proper development.

In one experiment during the past summer a certain lot of eggs was divided into two parts, one portion being placed in an ice-house and kept there for about forty days; the other being left in a room of the ordinary temperature. On the 20th of September each of these two portions was again subdivided into two, and one of each raised gradually to a temperature of 68 degrees. The portion that had been kept in the ice-house has lately hatched out, while the eggs of the other lot had not even formed an embryo, and it was thought probable, from the experience of previous years, that the embryo would not form until subjected to a certain degree of cold.

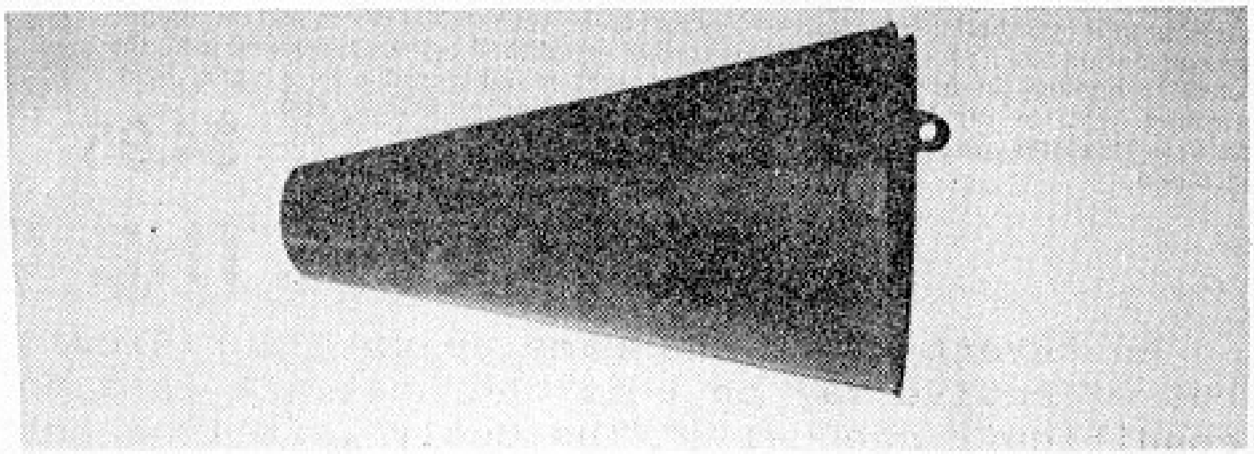
The remaining two portions have been kept in the ordinary way to be experimented upon in the next season.

It is inferred from the above facts that, while exposure to cold, either natural or artificial, is required for the hatching of the silk-worm egg, if the length of time be insufficient, or the degree of cold not great enough, an unhealthy worm will be produced, and that possibly to some such condition as this may be ascribed many of the

cool it to a temperature safe for the yeast. If it feels warm but not hot, dump a package of active dry yeast (not fast-rising or acting yeast) into the sugar and warm water. Stir it with a fork until it dissolves. Then put a plate over the pitcher and let it alone for about an hour. It will be covered with froth. Stir it again and then look to the mash.

Pour the mash into the cat-litter container. For this you will need a funnel, lest it slop. The best funnel is one bought at any auto-supply department and is used for putting transmission fluid in your engine. Cut the funnel off nine inches from the top. This will allow 1 1/2 inches down inside the container and 1 1/2 inches across to let the mash flow smoothly.

If the mash is warm but no longer hot, pour in the yeast and sugar and give the container a few sloshes. But don't try to get it totally mixed. If it should be mixed too



much, it might rise up and clog the tube. This would cause pressure and blow the lid off and mash would be all over the place.

If you don't use the cat-litter container, measure the one you use for at least 2 1/2 gallons. Never fill it with the mixture past the 2 gallon mark.

Now, put the container in the warmest part of your home, but not over 85 or 90 degrees. The warmer it is within the safe limits, the faster it will work.

With the cap on firmly and the tube in the jar, the bubbles should appear in an hour or so. After a few days, they will slow down and finally stop, at least except for a burp every couple of minuets.

Now you are ready to distill. It is too much trouble to separate the liquid from the mash. The cooked mash isn't too inclined to stick. But it is a good idea to add water to completely fill the container when it is ready to distill and then to shake it well before pouring some into the still. Thus diluted the mash is pretty much in suspension so it won't stick or burn. Fill the pot only two-thirds full and keep the heat at Medium.

When it heats up, the alcohol will come over in a

diseases which have in late years so sensibly affected the raising of silk-worms and the manufacture of silk.

To what extent these same conditions apply to the hatching of the eggs of any other insects has not been investigated; but the subject is one of much interest, and we presume that experiments will be tried and their results made known in due course of time.

EGG OIL.

A favorite remedy in Southern Russia for curing cuts, bruises, etc., consists in applying what is called egg oil, prepared by boiling the eggs hard, and then taking the yolks and crushing them, placing them over a fire, and stirring them carefully until the whole substance is on the point of taking fire. When the vessel is removed, the oil which has separated is to be poured off. Nearly two tea-spoonfuls of oil are obtained from a single egg.

PURIFICATION OF WATER.

The hypochlorate of iron is said to be one of the best substances known for purifying water; resembling alum in its action. A more simple method, however, consists in forcing air from an air-pump through a sieve-like tube, and continuing this for a considerable length of time. The oxygen of the air coming in contact with the organic substances in the water oxydizes them, and they fall to the bottom, with any mineral constituents that may be present, leaving the water perfectly pure. The length of time necessary to accomplish this object is not very great, a few minutes every day being sufficient to purify all the water needed by one family for drinking and cooking.

BROMIDE OF POTASSIUM FOR CHILDREN.

Certain French physicians very strongly recommend the use of bromide of potassium as a method of putting children to sleep, claiming that it is far preferable to the remedies ordinarily employed, especially those which contain opium—a substance whose use for this purpose can scarcely be too strongly reprehended. It is given in doses, for very young children, of from two to four grains, several times a day. The sedative action of this remedy is said to be apparent the first, or at most, the second night, and to continue as long as the medicine is administered. It is found to be extremely beneficial during the period of teething, as it appears to prevent convulsions by means of its anæsthetic action. One instance is mentioned in which a child, that had been subject for several months to convulsions, was entirely cured after a few days by the bromide.

WORKERS IN COPPER AND THE CHOLERA.

Attention has recently been called in Paris to the fact of an apparent exemption of workers in copper from attacks of cholera, during the various epidemics that have visited that city. It was found that, in the class of operatives referred to, the proportion of deaths among the adult workmen in copper, during the cholera season, did not exceed three to every ten thousand cases; while, among gold and silver smiths, the mortality was one in every seven hundred and nineteen. A nearly similar disproportion was observed in the case of those engaged in other occupations.

WATER-PROOF CLOTHING.

Material for water-proof clothing has been in use for many years, and is of great importance in our everyday economy. Rubber is, of course, the most perfect repellent of wet; but is very objectionable as preventing the escape of the insensible perspiration, and causing the exhalations from the skin to condense and produce a clammy sensation, rendering the wearer very liable to take cold when exposed to a change of temperature or to a draught.

Water-proof fabrics of woven material have been extensively used ever since the days of Mackintosh; and considerable improvements have latterly been made in the preparation of this article, which, while permitting the escape of the insensible perspiration, also excludes rain and wet.

The following recipe for rendering tweed and other similar cloths thoroughly water-proof has, it is said, been tested with satisfactory results. A liquid is prepared by dissolving half a pound of sugar of lead and half a pound of powdered alum in a bucket of soft water, and stirring the solution at intervals until it becomes clear, and then pouring it off into another bucket. The cloth or garment is to be immersed in this, and left for twenty-four hours, and then hung up to dry without wringing. Dresses prepared in this way will, it is said, resist the severest storms without allowing the moisture to penetrate, the rain hanging upon the cloth in globules. One person, we are assured, walked nine miles, in a very severe storm of wind and rain, and on the removal of his over-coat found his under-garments as dry as when he put them on.

ACTION OF HOP FLOWERS ON YEAST.

It is asserted by an Italian physiologist that the flowers of the hop arrest immediately the development of yeast, and thus prevent fermentation.

RENDERING HARD WATER SOFT.

In a late communication to the Academy of Sciences in Paris, the author recommends the use of oxalic acid for the purpose of neutralizing the lime in certain hard waters, which, by precipitating the lime as an oxalate, renders the water perfectly soft, and as fit for use in washing as rain-water. To this, however, the Secretary of the Academy, M. Dumas, responded that, in consequence of the varying proportion of bicarbonate of lime in the water, it would be difficult so to regulate the amount of oxalic acid as to prevent an excess remaining and acting as a poison; and he recommended instead of the acid, and as accomplishing the object more speedily, the use of milk of lime, which combines with the bicarbonate of lime and the free carbonic acid, and produces a precipitate of neutral carbonate. This method has been employed with great success for many years in certain manufactories at the suggestion of M. Dumas.

HALFORD CURE FOR SNAKE-BITES.

We have already referred to the method adopted by Dr. Halford, of Melbourne, for curing the bite of poisonous serpents, by injecting under the skin about thirty drops of liquor ammoniæ, and to the fact that his peculiar method of injecting ammonia has not succeeded in experiments in India and some other parts of the world. In a recent communication Dr. Halford remarks that as the power of the ammonia injected is expended, fresh supplies must be used, and that the greatest care must be taken that none of the ammonia be spilled, or sloughing will follow. He has changed his views in regard to the physiological action of the poison and of the remedy, to the extent that whereas, formerly, he thought that, in consequence of the entrance of the poison into the blood, a rapid growth of new cells occurred, which choke and exhaust both the fibrin and the oxygen of the blood, and render it incapable of any longer ministering to the wants of the system, he now thinks that the new corpuscles are only the ordinary white corpuscles of the blood strangely altered and colored, the change in them being caused by an alteration of the medium in which they float; this alteration being, in fact, a disappearance of the fibrin under the action of the poison. The ammonia, of course, in Dr. Halford's view, counteracts this power of the poison.

RELATION OF BLOOD TO LIFE.

IT has generally been supposed that the presence of blood in a state of circulation in the system is absolutely necessary to life, and that the cessation of such action is always accompanied by death. In a course of recent lectures by Professor Bernard, of Paris, he refers to this belief, and states that if one of the higher animals be

Continued on page 2311

fairly fast trickle. When the alcohol is all out you'll notice a decrease, indicating it is only water. Taste it. You'll know.

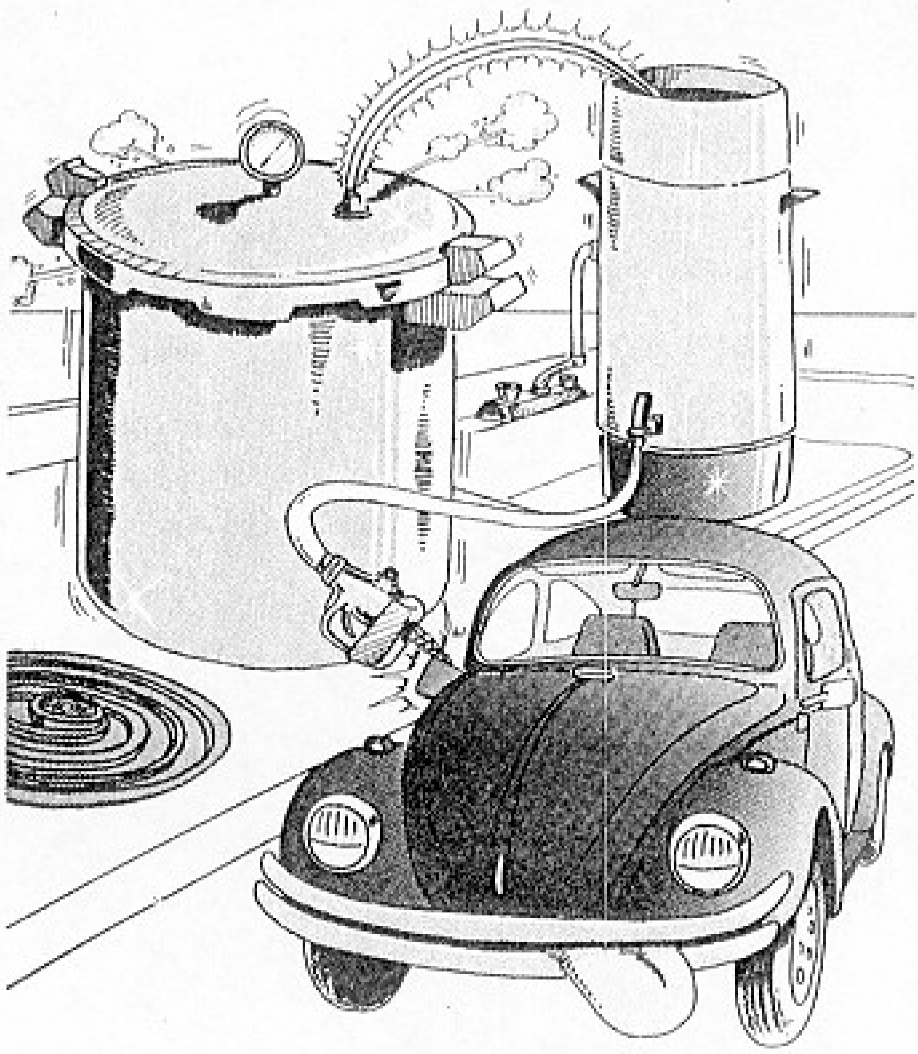
That is all there is to it!

So far, you've just learned the basics. If all this is totally unfamiliar, you might think it is too much to tackle. It isn't. Even so, you might make mistakes at first.

Think of yourself as a youngster watching your mother make a three-layer chocolate cake with icing. She barely looks at the the cookbook and it turns out great and tastes wonderful. Now you try it. You follow the recipe exactly. You wind up with a real mess.

You are not expected to do everything right the first time. You will blunder. But like your mother had to learn, to make it all look so easy, you will learn and you will be doing these processes while barely looking at the instructions.

Forget the Gas Pumps— Make Your Own Fuel



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This book is easy reading.
Read it through before doing anything.
It won't take long to read.
Maybe an hour.

I have a permit to make alcohol fuel.
And I'll tell you how you can get one too.
That way, you can make fuel the legal way.
I'll show you how to make simple and safe alcohol.

Don't be frustrated by any complex magazine articles you have read on making fuel.
I have read some of them.
It would cost a fortune to buy the materials they suggest.
Some of their technical jargon would scare an engineer.

I don't have much money.
So I use whatever I have on hand to make my fuel still.
I'll show you my simple way; the way mountain folks made it from things lying around in the yard.

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GET YE A COPPER KETTLE,
GET YE A COPPER COIL . . . .
TRADITIONAL

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2 Sprout the corn to make malt
3 Get a plastic pail (mash box)
4 Make the mash
5 Add the yeast
6 Let the mash ferment three to four days
7 Pour the mash into the pressure cooker
8 Cook the mash to 173 degrees Fahrenheit
9 Vaporize the alcohol from the mash
10 Condense the vapor into concentrated alcohol
11 Collect the alcohol in Mason jars
12 Test the proof
13 Raise your proof to 160 or over

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LET'S MAKE MALT

First you need to make malt. You make malt by sprouting corn. The sprouts grow out about one-half to two inches. The reason for sprouting the corn is to convert the starch in the corn into sugar. This resulting sugar is what the yeast will change into alcohol.

(Note: When buying whole corn from your seed & feed store, make sure it's non-hybrid. Hybrid corn produces well on first planting. However, the corn from that planting will not sprout more than about 10% and you will have a mess. So you must insist on non-hybrid corn from the feed store or grow it yourself if you can't find a farmer who grows non-hybrid corn).

I'll tell you how to make malt. Get 100 pounds of corn from your local feed store. Get two or four burlap bags (the number you need depends on their size). Or if you have some cheap pillow cases, they will work fine. Fill each bag only halfway full with corn, since the corn will expand to almost twice its size when sprouting. Tie the bags so the corn will not spill out. Now put the bags of corn in a tub of warm water for 24 hours. After 24 hours, pour the water off. Each day for three more days, pour 1 to 2 gallons of water on the bags. At the end of the fourth day, the corn kernels should have sprouts on them one-half to two inches long. The corn is now malted. During the time after the first 24 hours, be sure the bags of corn are not too awfully wet since that might cause rotting. This is something you will learn in time.

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Next, take this malted corn and grind it up into fine cornmeal. You can use a sausage grinder or meat grinder. Or you can crush it with a big rubber mallet if you need to. It's nice if this corn is ground up a bit coarser than the cornmeal you buy in the grocery store.

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(Note: All the material is here. Even blank pages separating the chapters, as well as the photos were counted as pages).

A WORD ABOUT SUGAR, YEAST & CORN

Any kind of sugar will do - cane sugar or beet sugar. You can buy this item at any grocery store - get about 40 pounds. Just in case you happen to have molasses, sorghum, honey or pure corn syrup, you can use any or all of them instead of the sugar.

A lot of country folks will tell you to go to your local baker and buy a one pound block of yeast. Well, that isn't necessary. City dwellers can go to any grocery store and purchase dry yeast that comes in packages. Dry yeast works just as well. You will need eight packages of dry yeast.

You might check around with local farmers, feed stores, and grain stores. Get the best deal on corn you can. Next gardening season, you might want to grow your own corn. You will need about 100 to 120 pounds of corn.

Moonshiners have traditionally used corn as a basis for their mash. Pictured is a 55 pound sack of corn, purchased at a feed store.

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MAKING THE MASH

Mash is the mixture of warm water, yeast, corn malt, and sugar. I was told of a time-tested recipe for making corn mash. Since moonshiners used large 55-gallon oak barrels to ferment their mash in, this is what the recipe is based on. If your container or barrel is smaller, you can get additional containers, or just cut the amount of each ingredient down in proportion. I suggest using plastic garbage pails from a discount department store.

100 pounds of ground up malted corn
50 pounds of sugar
1 pound block of bakers yeast or eight packages of dry yeast
Warm water

Simply pour all of these ingredients into the mash box and let them ferment. Be sure to fill the mash box up with warm water until it is four inches from the top. This will allow room for the foam to rise when it begins fermenting.

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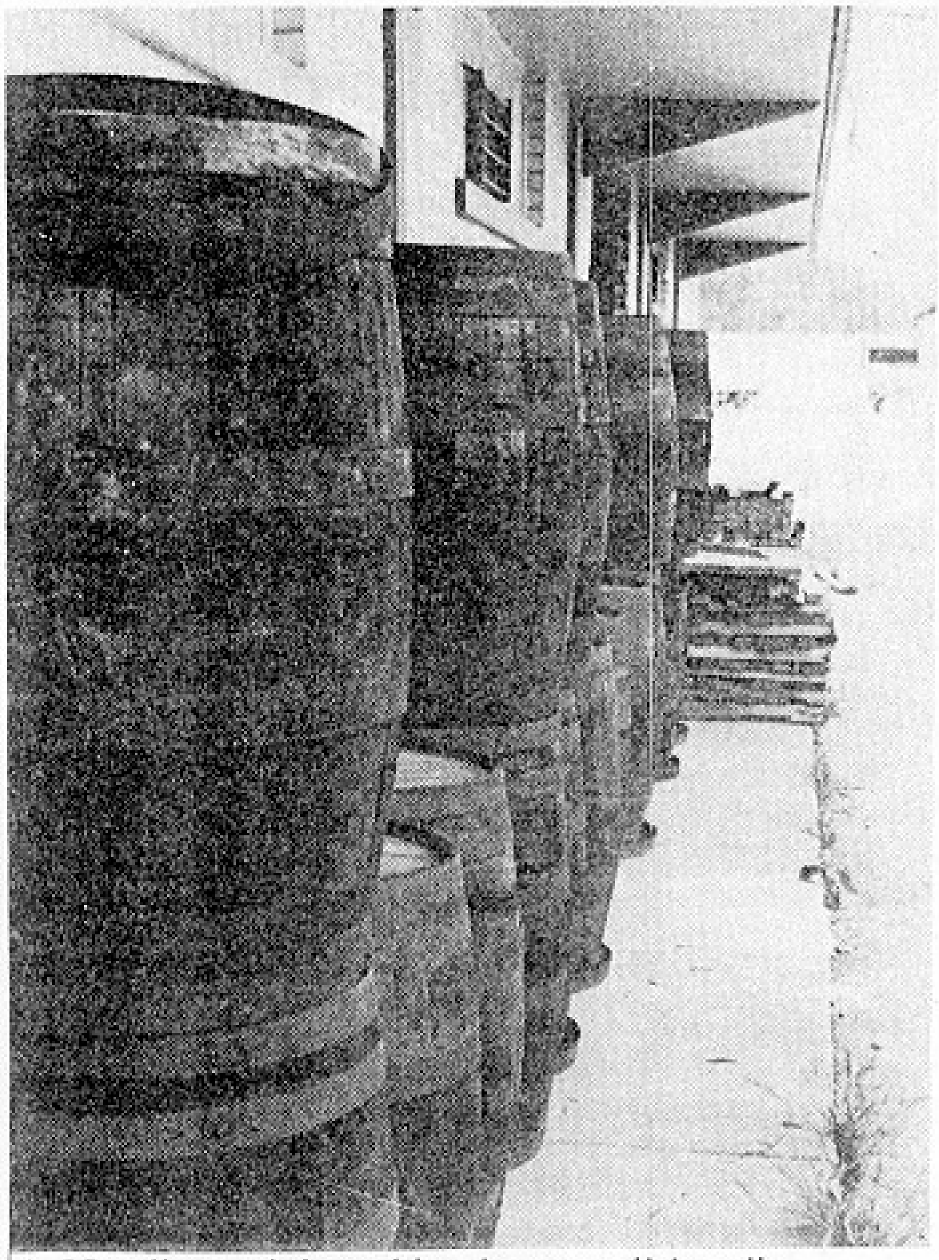
The mash will begin foaming as the yeast begins breaking down the sugar. As this happens, alcohol is being made. Now cover the mash box with a cloth or clean towel to keep out insects and dust.

After the foam has died down in three to four days, you will see tiny bubbles. This means the yeast has converted all of the sugar into alcohol. If you use a hydrometer from a wine supply shop, you will get a reading of somewhere between 12 and 14 percent alcohol. It is now time to distill.



A 55 gallon oak barrel has been traditionally used to mix and contain the mash. These can often be obtained from wineries and distilleries.

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LET'S DISTILL

When the mash is 12 to 14 percent alcohol, you have honest-to-goodness beer. Some moonshiners drink this and claim that it's better than beer you buy in grocery stores.

It is this beer that you are going to distill. I might use the term beer to mean mash, since both beer and mash are the same thing.

I don't want to get technical, but I picked this up from some country folks and I would like to pass it along to you. The word distillation means the separation of one substance from another by evaporation and condensation. You see, water vaporizes at 212 degrees, which is long after alcohol vaporizes. The trick is to heat the mash slightly above the temperature that alcohol vaporizes. This will be 173 degrees. At 173 degrees, alcohol will vaporize and water will remain in the mash.

When your mash is ready for distillation, you can cook the mash two different ways.

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The first way is to pour the total mash mixture of fermented corn and liquid into the cooker. When you do this, you end up getting the most quantity of alcohol out of the mash. The drawback is if the heat becomes too extreme, the corn might bubble over into the copper tubing causing it to clog. If you control the heat correctly and only fill the cooker to two-thirds capacity, you shouldn't have any problem with this happening. Cleanup is more involved due to the cooked corn in the cooker.

The second way is much cleaner, much safer, but you lose about 20 percent of the alcohol you could have made. You strain the mash over cheesecloth while allowing the liquid mash to pass through into the cooker, trapping the corn on the cloth. What you have in the cooker is clear, clean liquid which will not pollute your still with puking up boiling corn. You have no worries with clogging the copper tubing.

Both methods are used widely.

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COLLECT THE ALCOHOL IN MASON JARS

Pint size Mason jars are excellent to collect the alcohol in. I suggest filling them halfway, since the

proof of the product will be continually dropping as it is coming out of the spout. Number the labels of your bottles. You will test the proof later. For now, just fill each Mason jar to half its capacity.

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LET'S TEST THE PROOF

You can test the proof accurately by using a hydrometer that registers up to 200 proof. Remember 100 percent alcohol is 200 proof. Your proof is always double the percentage of alcohol.

After testing the percentage of alcohol in each bottle, you will want to mark each bottle with the amount of proof. Do this by dropping the hydrometer into each Mason jar. Write down the reading you get. Mark this proof on the jar label.

You need at least 160 proof to run a car engine. One hundred and sixty proof is 80 percent alcohol and 20 percent water. Anything that measures 160 proof to 200 proof can be used to fuel your car's engine. This mixture of alcohol and water should not hurt your car's engine.

If the alcohol in some of the jars doesn't measure up to 160 proof, you can raise the proof by pouring the lower proof alcohol back into the cooker, and running it through the still again. Let's talk about that for a while.

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HOW TO RAISE LOW PROOF ALCOHOL

Take the Mason jars of alcohol which measure below 160 proof and pour them back into the cooker. You are going to redistill this. This time it will only take half as long to vaporize and condense, since you are using already distilled alcohol. The whole process is faster the second time. You won't get quite as much back out as you poured in, but that doesn't matter since what you pour in is unusable for fuel. The proof of this second distilling will be much higher than before. Catch the alcohol in Mason jars just as you did before, but this time fill the jars to one-fourth capacity. Although the process is faster this time, and the proof is higher, the proof also begins to drop faster.

If you need to, you can take the low proof alcohol from this second distillation and run the alcohol through the still a third, fourth, and fifth time to boost the proof to 160.

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TROUBLE SPOTS

1 Before you operate the still, check each part of the copper tubing, from where it connects to the cooker to where it ends at the end of the coil spout. You should be able to hook a water hose up to the inside of the cooker cap where the lid is, and let the water flow through the whole still until it comes out the coil. If water freely goes through the whole still, then you are in good shape. If on the other hand the water cannot flow entirely through, then the cooker will explode since the steam will continue to build up and have no place to go. Be safe. Check this out carefully.

2 Sometimes the alcohol might come out looking milky or white; if you decide to cook the mash containing the corn and liquid both. The milky color means that the heat under the cooker is too high and is throwing mash into the distilling

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system. When this happens, the alcohol should be saved and tossed back into the cooker later for redistilling. But the most important step is to cut the heat under the cooker so all of the alcohol will not be bad. Pure alcohol is as clear as water. It

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has no color. Anything with a white color is impure and should be distilled again after the first run.

3 Once the alcohol begins to flow out through the coil spout, cut down the heat. It takes less heat to keep the still running once it has started. If you have the heat too high, your mash will splash into the copper tubing and might clog it. The dangerous thing is that the bubbled over mash 'called puke,' might clog up in the copper tubing and the steam will build up in the cooker until the cooker explodes. Bad news! Again, this may happen if you have mash in the cooker containing the fermented corn malt along with the liquid part of the mash. If you hear the sound of blub, blub, blub at the end of the coil, this means the mash is spilling over into the copper tubing. Cut down the temperature.

4 If you don't seem to have any alcohol coming out of the spout of the coil, be sure you have cold water flowing through the condenser box. Next check the cooker lid for leaks. Check each connection of the copper tubing for leaks. Without realizing it, all of the alcohol vapor might leak out before it condenses. If this happens, put plenty of dough,

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made from water and flour, on each connection.

(RECAP) Trouble spots to watch for are leaks or clogging in the copper tubing. Make sure the tubing is completely clear and allows the vapor to flow through easily without interruption. To avoid blockage of the tubing, (a) only fill the cooker with a maximum of two-thirds mash, and (b) keep the temperature at a steady 173 degrees, not any higher. Finally, all connections should have a generous amount of dough put on them to stop leakage. Also, put dough around the lid of the cooker.

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Getting Your Supplies Together

Part Two

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BASIC LIST OF MATERIALS

Plastic garbage pail: to hold mash
Warm water: from your kitchen sink
Whole grain corn: 100 pounds
Sugar: 50 pounds - any kind
Yeast: 1 pound of bakers yeast or 8 packages of yeast
Burlap sacks or pillow cases: about 4
Hydrometer or alcoholometer: measuring 200 proof
Copper tubing: 20 feet of light weight, about one-half inch in diameter
Pressure cooker: kettle, oil drum or other cooker
Gas stove: or other source of heat
Mason jars: pint size with lids
Labels: any type for Mason jars
Bucket: for coil to fit in
Cloth: cheesecloth to fit over mash boxes

OPTIONAL LIST OF MATERIALS

Sausage or meat grinder: grinding malted corn
Hand torch: heat copper tubing for bending
Sand: to fill copper tubing

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LET'S GET A MASH BOX

The mash box is where all of the goodies ferment. The goodies include the corn malt you made, yeast, sugar, and warm water. When all of these are mixed together, you have made mash. This mash will foam and in about three days, it will turn to approximately 12 percent alcohol. Anyhow, you have to have a container to put these goodies in. Mountaineers would use a clean barrel. Some of them would make a mash box out of wooden boards. Whatever you use, it must not leak, since there will be water in the container.

There are several options for your mash. You can use a cleaned out plastic garbage pail. You may need several of them. Go into a grocery store and ask for some containers that slaw and salads come in. These are fairly large, plastic containers with lids on them. You can get these for a buck or so - if not free.

For those of you who might choose to make your own mash box out of wood, be sure not to allow any nails or screws to come in contact with the mash.

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Metal will poison the mash, unless the metal is stainless steel or copper. Don't use fir or pine wood to make a mash box. You might get turpentine in your mash. A glass or ceramic container will work well. Spend an hour and look around your home before pulling out any money to buy anything. You can surely find some type of container that might do the job.

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LET'S GET A COOKING POT

Let's get one thing straight before someone gets poisoned. For drinking purposes, never use any metal for your cooker except stainless steel or copper. If you use any other metal including galvanized steel or aluminum, you may land flat on your back six feet in the ground. The reason is because the alcohol and metal will create a chemical reaction that may be toxic to a person. Many people die from drinking moonshine this way. Therefore, do not use anything for your cooker except copper and stainless steel, if you are planning to drink the alcohol.

Second, it is illegal to drink the alcohol you produce unless you operate as any distillery would under the power of the Bureau of Alcohol, Tobacco, and Firearms. I will tell you how to get a permit for making alcohol for experimental fuel. [But not for drinking!]

The ideal cooker is a stainless steel pressure cooker such as a restaurant might use. If you locate one, it will be expensive. Most pressure

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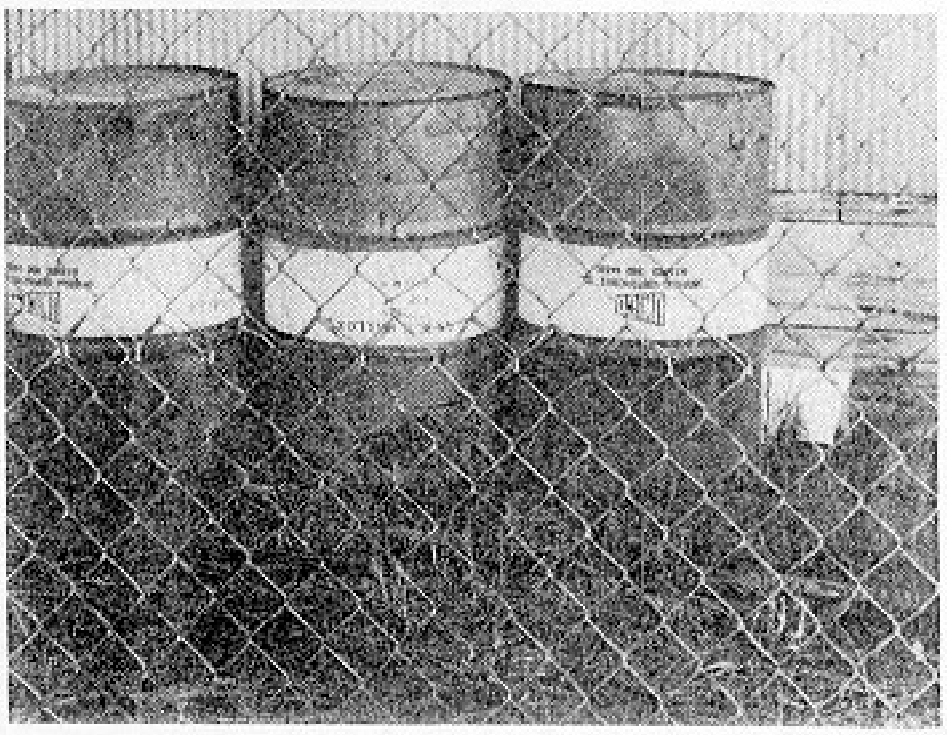
cookers today are made of aluminum. Most discount department and hardware stores have models which go to 22-quart capacity.

One other option for the cooker is an oil drum. There are two types of tops manufactured on oil drums. Be sure to choose the right type. One type

of lid comes off and you put it back on. This is the type you will want to choose. The other type has a top that doesn't come off, yet it has a cap called a bung which allows the liquid to be poured in and out. Do not choose this type.

If you get an oil drum, be sure to scrub it out well and get any chemicals out. For making a lot of fuel, these oil drums will work perfectly. They can be picked up at most chemical supply companies at a very low cost - maybe $5 to 10.

Whether you use a pressure cooker, oil drum or other container for the cooker, you will need a hole in the lid to allow the alcohol vapors to escape. The pressure cooker already has a hole on the top for the pressure gauge.



Standard oil drums, obtained from chemical companies, make excellent cooking containers.

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If you use a pressure cooker, you will want to make these few adjustments. Remove the pressure release valve on top of the lid. Now you have a hole for your copper tubing to fit into. This hole is where the alcohol vapors will leave the cooker.

Go to a hardware store, plumbing supply or air conditioning and heating supply house and buy a set of fittings (take your pressure cooker with you so you can get the correct size fittings) so you can connect the copper tubing onto the pressure cooker hole. If your pressure cooker has old deteriorating gaskets, replace them with new ones. You want everything sealed up tight to prevent leakage.

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HOW TO PREVENT LEAKS

The big problem that most people have is the vapor leaking. There is one known way to prevent leaks. This is done by sealing every connection with dough. This dough is a thick paste made by mixing flour and water. It should be thick. Put a lot of dough on every connection . Put a lot of dough at the connection around the lid to the cooker. Also, put dough where the copper tubing connects to the lid.

When the still is in operation, the heat from the cooker will dry the dough, and the dough will become hard, sealing the connections.

HEATING SOURCE

Any heating source will work. A gas stove or gas burner would be very suitable since it has an adjustable flame. You can also use an electric burner. You will be heating the cooker to 173 degrees. At this time the mash will vaporize, and be forced into the lid with the copper tubing connected to it.

THE COPPER TUBING

The copper tubing will be connected to the hole in the lid of the cooker. The copper tubing will extend from the cooker and make an arm. I suggest letting the arm extend for two feet, then have the fittings placed on it and on one end of the remaining copper tubing. With fittings, you can disconnect the copper tubing at this point when you wish to

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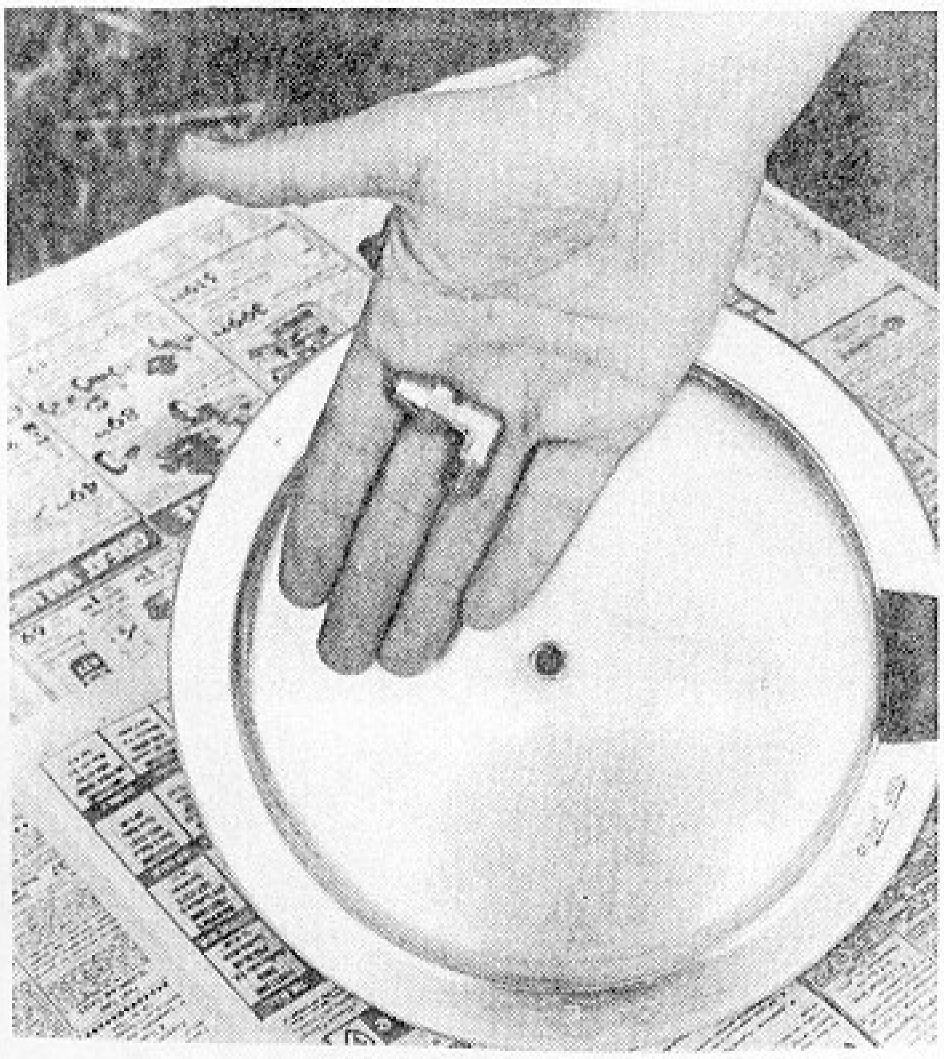

Step one in converting your pressure cooker into a cooking pot for mash is to remove the release valve on the lid, and add the new connection as shown above.

take it apart. You will need about 12 feet of copper tubing. The arm will take up two feet. You will now have ten feet of copper tubing including a placed fitting on one end so it will connect to the arm.

Take the ten foot piece of copper tubing and make a coil with it, but be careful. You will want your coil small enough in diameter to fit into a bucket, small barrel or whatever you have to house the coil. You will not need a lid for this bucket. The coil will fit into the bucket, and the end of the coil will come through a small hole that you will need to make toward the bottom of the bucket. The end of the copper tubing is where the alcohol will come out. The bucket serves two functions. First, it holds the coil. Second, and most important, it is filled with cold running water. This cold running water is abso-

Go to a hardware store and purchase fittings for your converted pressure cooker so you can connect copper tubing onto the lid.

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lutely necessary in order to convert the alcohol vapors in the coil into liquid alcohol. You might wish to drill out a drain hole at the bottom so running water can drain out at the same speed as the water enters. Some people don't use running water. They fill the barrel with cold water, and after the water begins to start to get warm, pour it out, and pour in fresh cold water.

When the coil comes out of the hole in the barrel, be sure to have Mason jars to collect the alcohol in. I will refer to the end of the coil as the spout. This is where the alcohol will flow out.

HOW TO MAKE THE COIL

There is an art in making the copper coil. If you

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bend the coil too fast or the wrong way, you will kink and ruin the pipe. So take it slow. I will share three methods to making a coil.

The first method is to go to a hardware store and get coiled copper tubing that fits a refrigerator. If you do this, all your work is done for you. At the time of this printing, it costs $.49 per foot. All you have to do is find a barrel that will house the coil.

Since this coil is big in diameter, you will need more than the 12 feet I mentioned earlier. Get enough to make an arm that connects to your cooker including a few feet to run to the mash box. Also, you need about 13 turns in your coil, and a foot for the spout. Thirteen is the traditional number of turns used by Kentucky moonshiners. You can use more or less turns in your coil than thirteen.

The second method is to buy straight copper tubing and bend it into a coil by filling the tubing with sand first. Be sure the copper tubing is completely

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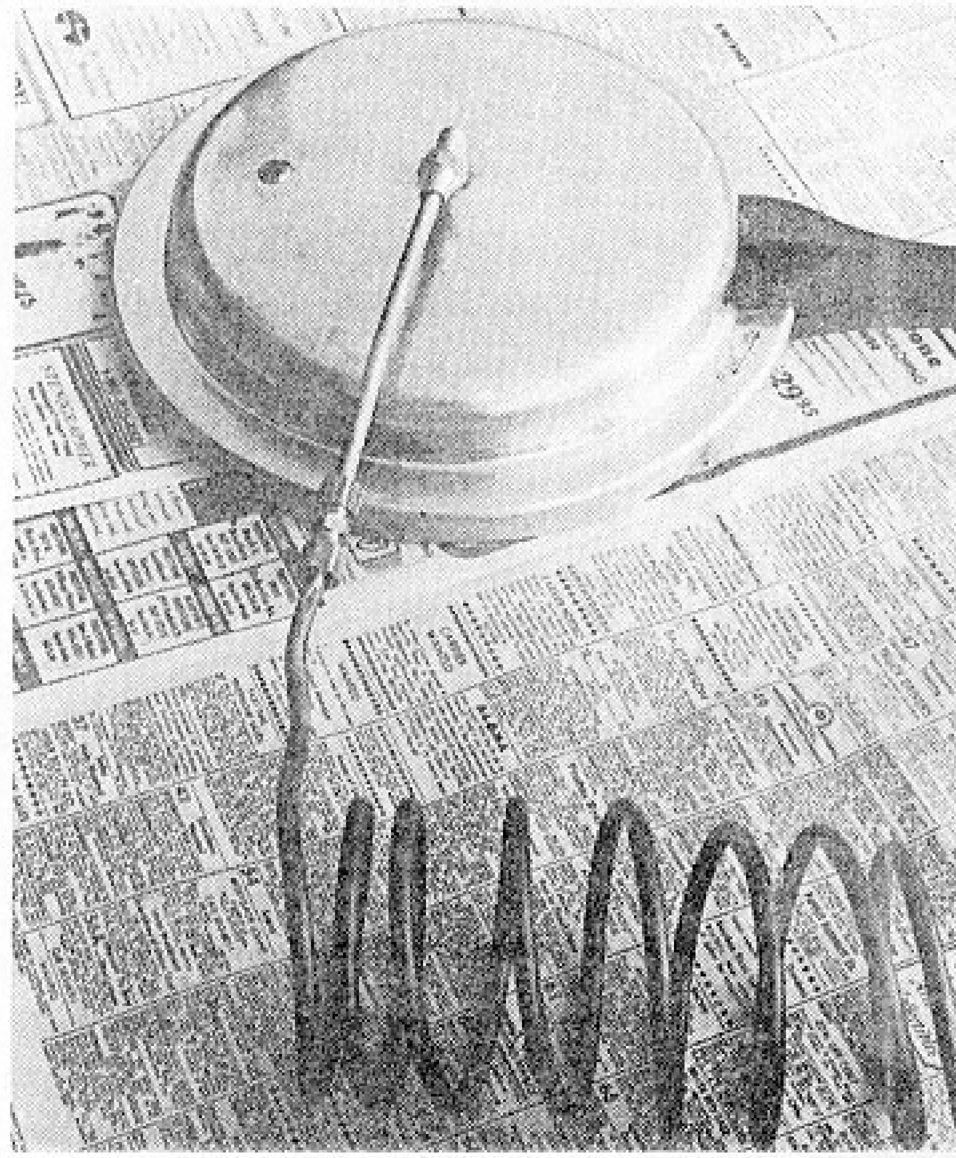
filled with sand, then close up both ends so the sand will not leak out. Now wrap this copper pipe around a long pole or pipe with a diameter that will fit into whatever container you have selected for your coil to fit into. We will call this container a condenser barrel. Slowly, very slowly, wrap the sand-filled copper tubing around and around until you have your 13 turns, then allow one foot for the spout. Next, drain out the sand and wash the coil out well. This sand will keep the tubing from kinking as you wrap it around the pole.

The third method is to buy straight copper tubing and make the coil without filling it first with sand.



Instead of using sand, you will prevent kinking by heating the copper tubing first. Moonshiners often place the copper tubing over a fire for 30 to 40 minutes. Then they would be able to bend the tubing into a coil without any kinking.

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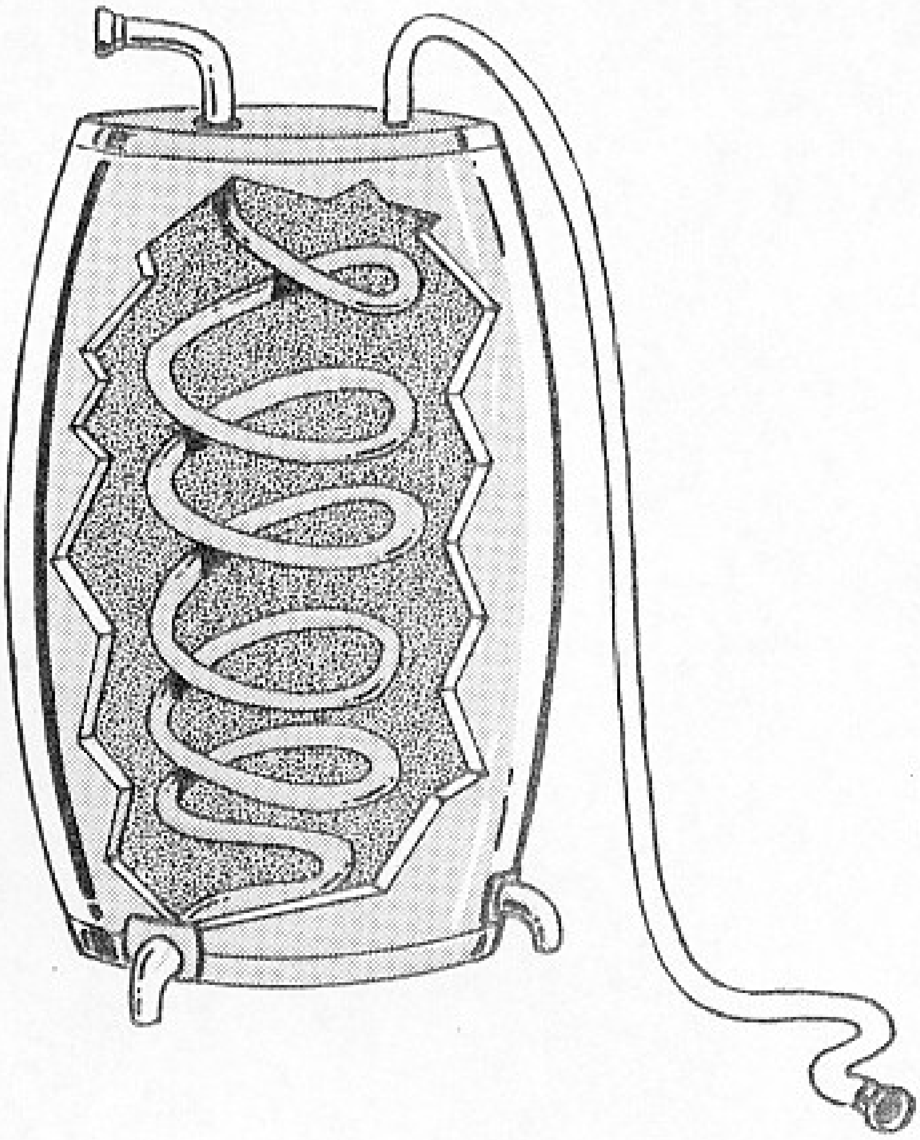
THE CONDENSER BOX

This is what the coil will fit into. This box must not leak, since you will need to keep it filled with cold water during the distilling process. The condenser box can be made out of metal or wood. We don't need to be picky. People in the mountains would use an oil drum for a condenser box. Anything that will hold the coil and water will do. It is probably best to make a hole at the bottom for the running water to run out of. Remember, cold running water will be flowing into this box all of the time. Another hole toward the bottom should be made for the spout of the coil to come out of. You will want

the spout hole to be in the front bottom of the box, while the drain hole should be in the back bottom of the box.



Illustrated is the condenser with the copper coil inside. It is a simple housing for the coil and cool, flowing water that changes the vapor into liquid.

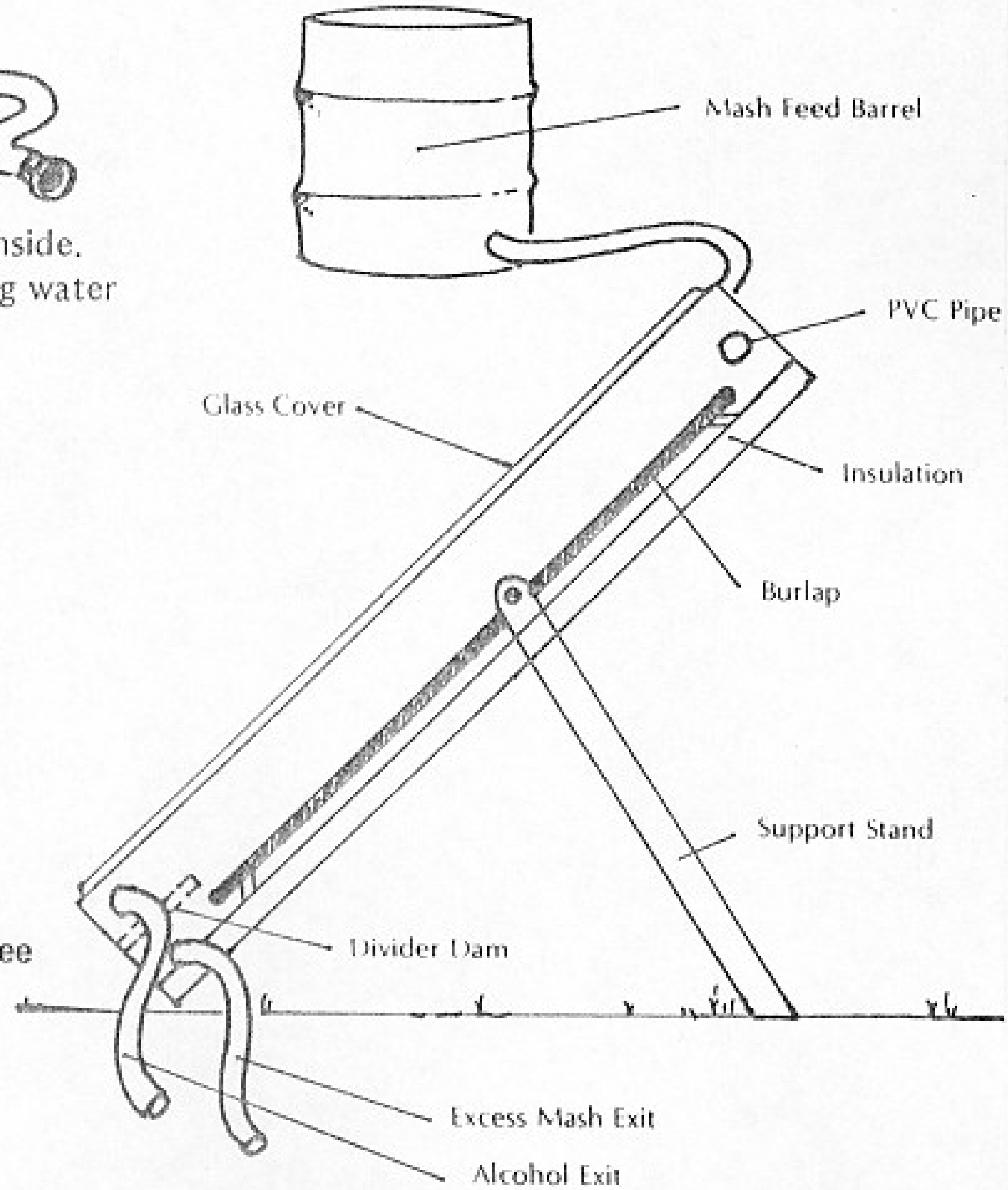
45 How To Build A Solar Still 47

Part Three

SOLAR STILLS

Solar stills are simple. Since you are using the sun for the heat to vaporize the mash, you are limited to daytime use, and only when the sun is shining. The materials needed for a solar still are a wooden box, fiberglass for insulation, black terry cloth towel or dyed black burlap, PVC pipe (one-half inch in diameter), copper pipe, sheet of glass to cover the wooden box, and a barrel of mash.

This is how the solar still works. The barrel of mash is on a tall stand and supplies mash to the towel or burlap. This is done by a PVC pipe which has one-eighth inch holes every two inches on the pipe. This causes a steady and even stream of mash to wet the towel or burlap. The sun heat comes through the glass on top of the box and is absorbed by the towel or burlap. Vapor is released from the mash onto the towel and it condenses on the inside of the glass, runs to the bottom, and is collected by



SIDE VIEW OF A SOLAR STILL

a gutter pipe (a PVC pipe split in half will do). This gutter pipe channels the alcohol into a pipe which carries the alcohol out of the still into your jars.

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The still should be tilted a little to allow the alcohol to flow out of the gutter pipe.

The glass should be slanted at an angle, maybe about 30 degrees. Experiment and see what degree angle causes maximum sunlight absorption.

Paint the wood black. Your burlap sack or towel should be dyed black. Black absorbs heat.

Keep the glass sparkling clean. Never let dirt or dust remain on the glass. This cuts off sunlight, and the amount of alcohol you could make will decrease.

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ADVANTAGES OF A SOLAR STILL

1 The solar still is very simple in design. You need very few materials.

2 You use the sun for your heat source. There is no expense for a conventional heat source.

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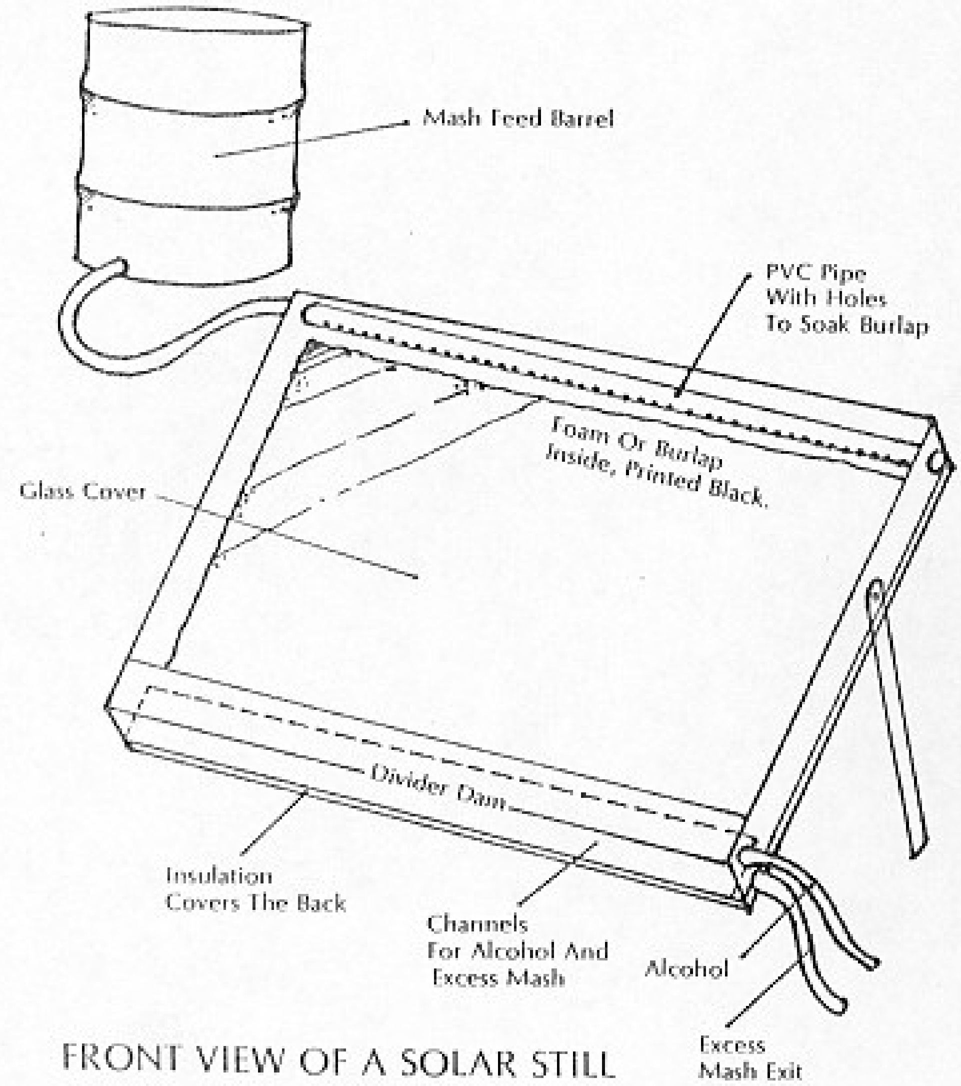
DISADVANTAGES OF A SOLAR STILL

1 You may have intermittent sunshine and not enough sunlight to complete your distillation. Clouds or a storm might get in the sun's path.

2 Your mash might turn to vinegar before you have enough sunshine to complete your distillation. Once your mash is ready to distill, you must run it through the still whether you have sunlight or no sunlight. Otherwise, the mash might turn to vinegar; enough vinegar to season your food for several years.

With the advantages and disadvantages in mind, let's turn to look at the side view and front view of a solar still. You will want to do your own experimentation with the size of this still, setting it up, and ironing out the bugs. These illustrations will give you a basis to begin.



FRONT VIEW OF A SOLAR STILL

The PVC pipe at the top has holes in it which allow a steady stream of mash to saturate the burlap or terry cloth (both dyed black). The gutter, which can be a PVC pipe split in half, is located at the bottom of the glass. This gutter collects the alcohol and channels it out through the side pipe.

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How To Make Your Car Drink Alcohol

Part Four

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HOW TO RUN YOUR CAR ON ALCOHOL

Most of these adjustments are going to be made on the carburetor. You might want to go to an auto parts store and get a rebuilt carburetor for your particular car, so you can experiment with it and convert it to run on alcohol. That way, you will have this carburetor whenever you choose to run your car on alcohol. And you will have the original and unconverted carburetor when you want to use gasoline.

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ADJUSTMENT NUMBER ONE

You will need to enlarge the main fuel jet in your carburetor 40 percent larger in diameter. Some cars will have more than one main fuel jet. You will need to enlarge all main fuel jets. The reason for doing this is the ratio of alcohol to air is different than the ratio of gasoline to air. You can enlarge the jet or jets with an electric drill, or you may want to have this done by a mechanic. First, find the exact size of the jet by looking at a specification chart of a car repair manual. Or you can measure the diameter of the hole in the jet if you have the proper tool. The best way is to look into a car repair manual.

Once you find the diameter of your jet, write it down. Next, multiply it times 40 percent or .40. Write this number down. Add the two numbers together and you have the exact diameter the new jet hole should be.

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Example

.0500 Size of jet in car
Multiply by 40 percent or .40

.0500
x .40

.0200

Now add both numbers

.0500	Size of jet in car
+	
.0200	40 percent

.0700	Size of diameter for jet to run on alcohol

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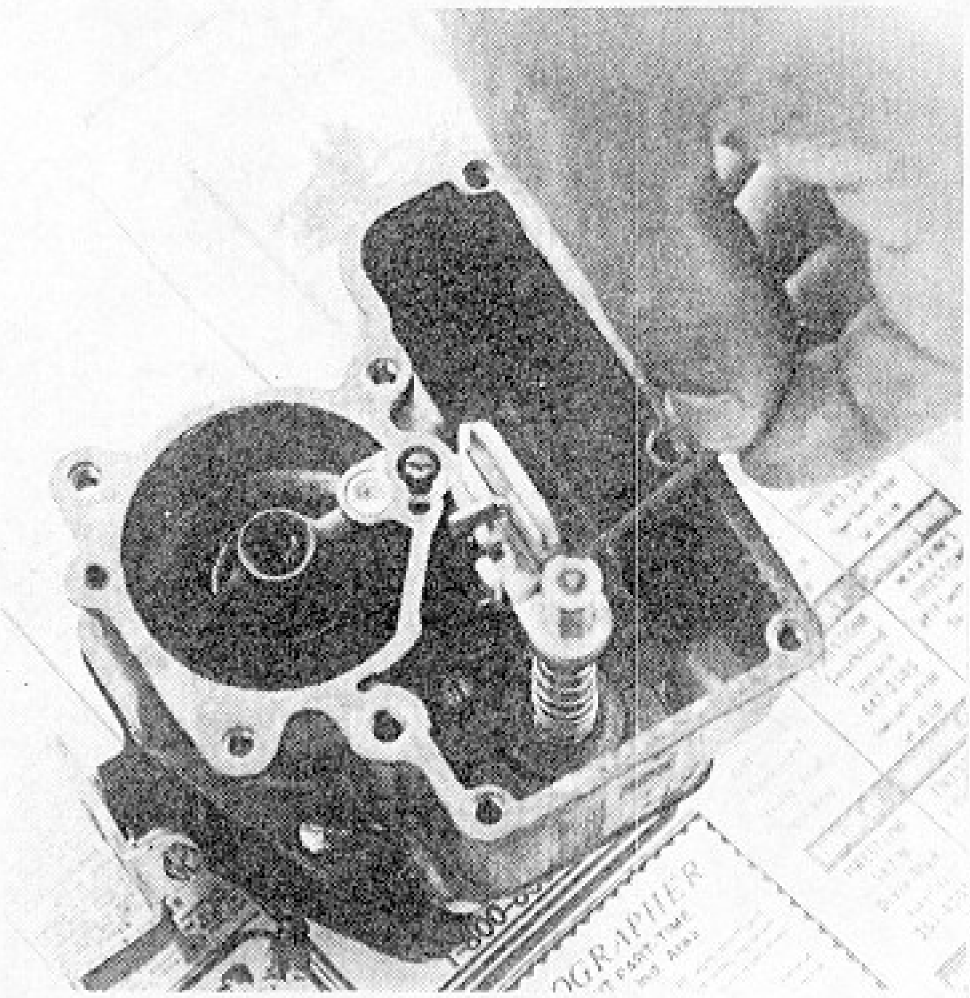
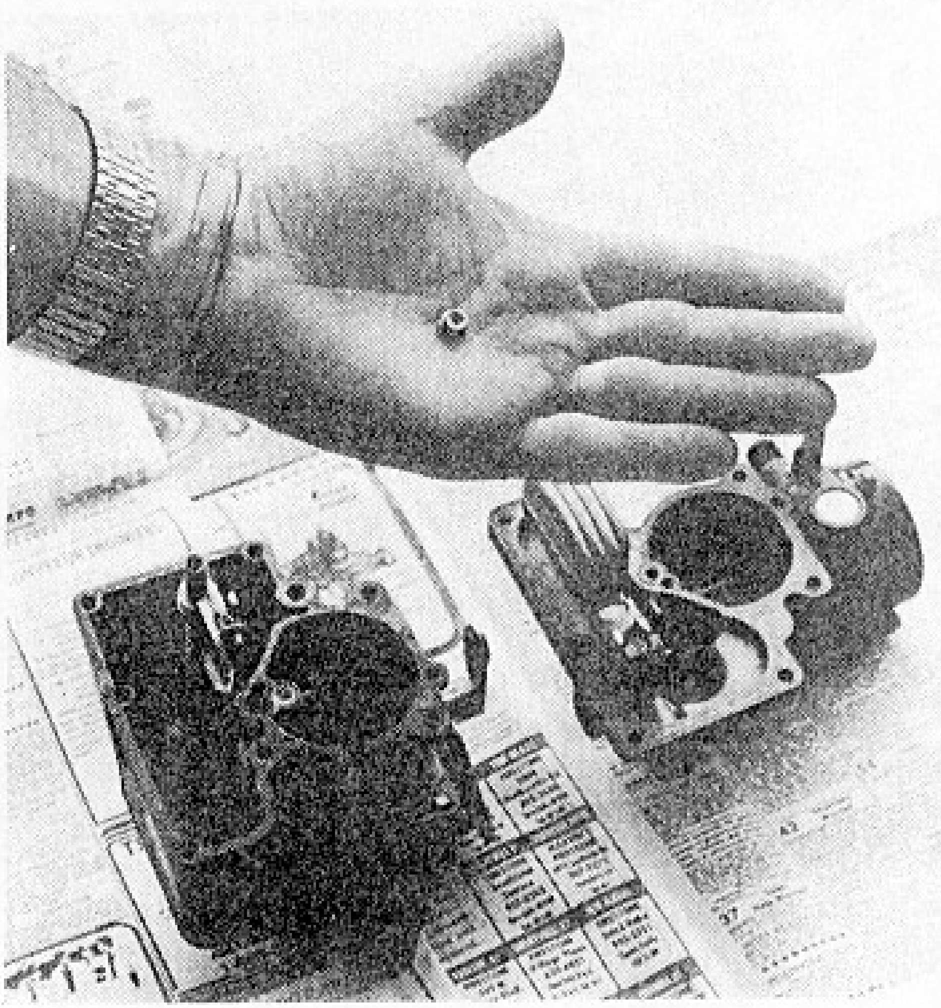
With the math done, you need to find a drill bit that is the diameter of this new jet size. Locate a machinist's book with the standard chart, 'Decimal Equivalents and Tap Drill Sizes'. For the size of the jet mentioned above, locate .0700 in the decimal equivalent column. Directly in front of that .0700 you will find a drill size, which happens to be 50. I would need a Number 50 drill bit. The bit would be used to drill out a new hole in the main fuel jet or jets.

If your exact decimal equivalent is not located in the book, simply find the decimal equivalent which is the closest in size to what you are looking for, and use the drill bit number that corresponds. It will work fine.



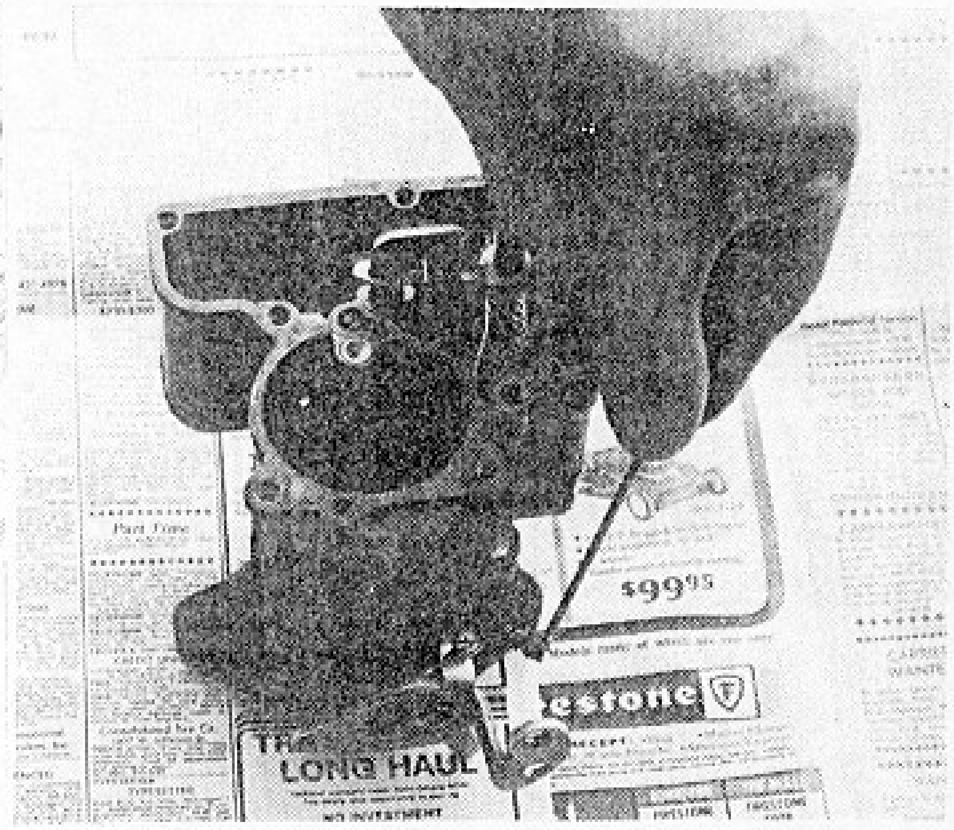


ABOVE
Mechanical consultant Keat Drane holds the main fuel jet from a "one--barrel" carburetor. This jet must be enlarged 40 percent. A "two--barrel" carburetor will have two main fuel jets. A "four--barrel" carburetor will have four main fuel jets.

LEFT
The pointer indicates the location of the fuel jet.

ADJUSTMENT NUMBER TWO

The screws on the bottom of your carburetor which control the idle should be opened up.



The pointer indicates the location of the idle screw on the carburetor.

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ADJUSTMENT NUMBER FOUR

Since so many late model cars come with an automatic choke, you will need to install a manual choke. Go to an auto parts store and get a manual choke in kit form, specified for your car. The manual choke will allow you to open the choke when the electric window wiper unit squirts gasoline into the carburetor venturi. You will be able to adjust the amount of alcohol and air mixture when needed.

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How To Get Your Permit

Part Five

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HOW TO GET A PERMIT TO MAKE ALCOHOL

Getting a permit is very simple. You compose a letter containing certain information and xerox three copies to be sent to your regional Bureau of Alcohol, Tobacco, and Firearms. Keep the original letter. I have listed the addresses of the regional offices you will need to deal with.

You will receive a letter of acceptance with a small bond to be required. If you keep the amount of alcohol you want to make small, the bond will be much less.

Notice in my application I stated that I plan to produce up to five gallons of alcohol within a 15 day period. My bond was figured at $100. You can fill out a special form to put up collateral. I just sent in a check for $100. I will get my bond money back when I decide to stop making alcohol fuels. No interest is paid on the money.

On the next page I have copied my own application. You might want to study it and use it as a model. Make it applicable to your own conditions.

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From: James E. Wortham
2176 Allison Lane
Jeffersonville, Indiana 47130

To: Regional Regulatory Administrator
Bureau of Alcohol, Tobacco & Firearms
6519 Federal Office Building
550 Main Street
Cincinnati, Ohio 45202

Date: July 8, 1979

RE: PERMIT: Permission to establish an experimental distilled spirits plant as per Title 27, Code of Federal Regulations, Section 201.65.

a) Description of land and building which will comprise the plant: The still will be operated in the kitchen of the home address above.

b) Description of the equipment to be used. A five gallon plastic, sealable bucket to ferment the organic matter, a pressure cooker to heat the fermented organic matter, and also copper

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tubing to collect and channel the vapor into a condensation barrel.

c) Description of process to be employed: The process of the classic boiling still, as described in point (b) above.

d) Description of the nature, extent and

purpose of the proposed plant: It is my desire to test several sources of fermentable grains (corn, barley, rye) and fruits (peaches, grapes, pomegranates, plums, pears, raisins, dates), and to experiment with the alcohol distilled, for reasons of discovering home uses of this alcohol, including uses in oil-fired furnaces, lawnmowers and small appliances.

e) Description of the security measures so that the alcohol produced will not be removed for an unauthorized purpose: Only small amounts of alcohol will be produced, and only the amount needed by me to experiment as fuel for furnaces and lawnmowers and small appliances

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which might operate on alcohol. The place of operation will be locked so no unauthorized persons can enter.

Estimated amount of alcohol (proof gallons) that will be produced within a 15-day period: The proof of spirits will be 140 to 200 proof; the number of gallons is not expected to exceed five gallons within a 15-day period.

Signed by applicant

Date

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REGIONAL OFFICES . . .
BUREAU OF ALCOHOL, TOBACCO & FIREARMS

Send three xeroxed copies of your letter of application (keep the original for yourself) to the regional office for the state you live in. I have listed each regional office on the chart .

ADDRESSES OF ATF REGIONAL OFFICES

CENTRAL REGION Indiana, Kentucky, Michigan, Ohio, West Virginia	Regional Regulatory Administrator Bureau of Alcohol, Tobacco and Firearms 550 Main Street Cincinnati, Ohio 45202
MID-ATLANTIC REGION Delaware, District of Columbia, Maryland, New Jersey, Pennsylvania, Virginia	Regional Regulatory Administrator Bureau of Alcohol, Tobacco and Firearms 2 Penn Center Plaza, Room 360 Philadelphia, Pennsylvania 19102
MIDWEST REGION Illinois, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, Wisconsin	Regional Regulatory Administrator Bureau of Alcohol, Tobacco and Firearms 230 S. Dearborn Street 15th Floor Chicago, Illinois 60604
NORTH-ATLANTIC REGION Connecticut, Maine Massachusetts, New Hampshire, New York, Rhode Island, Vermont, Puerto Rico, Virgin Islands	Regional Regulatory Administrator Bureau of Alcohol, Tobacco and Firearms 6 World Trade Center, 6th Floor (Mail: P.O. Box 15, Church Street Station) New York, New York 10008
SOUTHEAST REGION Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, Tennessee	Regional Regulatory Administrator Bureau of Alcohol, Tobacco and Firearms 3835 Northeast Expressway (Mail: P.O. Box 2994) Atlanta, Georgia 30301
SOUTHWEST REGION Arkansas, Colorado, Louisiana, New Mexico, Oklahoma, Texas, Wyoming	Regional Regulatory Administrator Bureau of Alcohol, Tobacco and Firearms Main Tower, Room 345 1200 Main Street Dallas, Texas 75202
WESTERN REGION Alaska, Arizona, California, Hawaii, Idaho, Montana, Nevada, Oregon, Utah, Washington	Regional Regulatory Administrator Bureau of Alcohol, Tobacco and Firearms 525 Market Street 34th Floor San Francisco, California 94105

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On the next two pages you will read the application procedure that was given to me by the Bureau of Alcohol, Tobacco, and Firearms. This is what I used while typing my letter of application

which you just read.

These two pages will give you all of the information you need to know.

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DEPARTMENT OF THE TREASURY
BUREAU OF ALCOHOL, TOBACCO AND FIREARMS
Room 872-C Federal Building
Louisville, Kentucky 40202

The Regional Regulatory Administrator is now authorized to approve the establishment and operation of experimental distilled spirits plants. Such plants can only be established for specific and limited periods of time solely for experimentation in, or development of:

(a) Source materials from which spirits may be produced;

(b) Processes by which spirits may be produced or refined; or

(c) Industrial uses of spirits.

In order to establish an experimental distilled spirits plant in the Central Region (the States of Indiana, Kentucky, Michigan, Ohio, and West Virginia), the applicant must submit a letter, in triplicate, to: Regional Regulatory Administrator, Bureau of Alcohol, Tobacco and Firearms, Room 6519 Federal Office Bldg., 550 Main Street, Cincinnati, Ohio 45202. The application must:

(a) Describe the land and buildings which will comprise the plant. The description must include the physical location of the plant and all tracts of land where the alcohol will be used as a fuel;

(b) Describe the equipment to be used. This includes the still(s), collection tank(s), and the machinery in which the alcohol will be used as fuel;

(c) Describe the process to be employed in mashing and distilling, and the material from which the mash will be produced;

(d) State the nature, extent, and purpose of the plant;

(e) Describe the security measures provided so that the alcohol produced will not be removed for an unauthorized purpose. (Reasonable security must be provided against theft by intruders.); and

(f) An estimate of the number of gallons of alcohol that can be produced within a 15-day period.

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Any application submitted by other than an individual (trust, estate, partnership, association, company, or corporation) must be accompanied by authority of the signator to sign for the applicant. If two or more persons wish to operate a plant but only one member of the group signs the application, the application must be accompanied by an agreement binding the remaining individuals to the conditions of the application.

In instances where the applicant does not have legal possession of the premises constituting the plant, the property owner must recognize, in writing, that ATF officers have the right of access to the premises for purposes of inspection.

Any spirits produced in an experimental plant must be used for experimental purposes, as outline above. The alcohol so produced may be used in farm vehicles moving from one tract of the plant premises to another or in vehicles operated on public roads provided the alcohol is mixed with at least 50 percent gasoline. Prior to operation of the plant, the proprietor must comply with state and local requirements.

If the application is approved, a distilled spirits bond in an amount sufficient to cover the Federal excise tax on alcohol produced during any 15-day period must be filed, and notice of acceptance of the bond received before alcohol may be produced.

When your application is received it will be given prompt consideration. If any additional information is needed, please let us know.

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THE RULES OF THE GAME

1 You can use the alcohol you make as fuel to operate your vehicles from one tract of the plant premises to another.

2 You can operate your vehicles on the public roads provided the alcohol you make is mixed with at least 50 percent gasoline. Read the next section on gasohol.

3 You are not allowed to sell, drink, or give away the alcohol you make.

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GASOHOL

There is much confusion concerning the difference between alcohol and gasohol. Let me mention some of the facts.

A car will run very well on nothing except alcohol. In fact, the original Model T Ford was made to run on alcohol or gasoline or a combination of both. If you run your car on alcohol, you will need to use at least 160 proof. I am aware of people who are running their cars on 100 proof alcohol. (50 percent water - 50 percent alcohol) If you use this low proof alcohol, you will lose about one-third of your engine's power. Your car may also stall at a stop light or have very slow pick-up. If these things don't worry you, go ahead and experiment with low proof alcohol. Once you reach 160 proof, you should not have any noticeable difference in performance between 160 and 200

proof.

Remember that motorcycles, lawnmowers, and other machines with a combustible engine will run on alcohol. Absolutely no gasoline is needed. But

you will, of course, need to make small adjustments as I mentioned in an earlier chapter.

Now let me switch to gasohol. Gasohol is a mixture of 200 proof alcohol and gasoline. Commercial dealers are selling gasohol containing nine-tenths gasoline combined with one-tenth (200 proof) alcohol. With gasohol, 200 proof alcohol must be used since you cannot have water mixed with the gasoline-alcohol mixture. Water and gasoline don't mix. If you have ever had water in your gasoline, you are familiar with problems of starting your engine, stalling at stop lights, slow pick-up, and low engine performance. The fact that 200 proof alcohol is used, runs the price of gasohol up. Thus, the price of gasohol is inflated, by using nine-tenths gasoline in the mixture. Using this much gasoline will have limited success in saving our oil resources.

To recap, an engine will run on alcohol with minor adjustments in the carburetor. Alcohol doesn't need to be mixed with anything. Gasohol is a mixture of alcohol and gasoline which is expensive to produce and expensive to buy.

Unfortunately, government regulations at the date of this writing requires any vehicle taken on an open road, using homemade alcohol, to be mixed with 50 percent gasoline. Gasoline is required in order to tax a portion of the fuel.

Kinds Of Alcohol

Part Six

KINDS OF ALCOHOL

The term alcohol refers to several different types of alcohol. They are made in various ways and have many different uses. I will briefly mention five types of alcohol including isopropyl, glycerol, butyl, methanol, and ethanol.

Isopropyl is used in antifreeze, solvents, and antiseptics. Isopropyl is a common component of rubbing alcohol.

Glycerol (sometimes called glycerin) is a clean, sweet tasting, colorless or pale-yellow, syrupy liquid. Large amounts are by-products of soap manufacture. Glycerol is easily digestible and nontoxic. It is used for skin lotions and other cosmetics, and as a moistening or texturing agent in prepared foodstuffs. One of the main industrial uses is in the manufacture of nitroglycerin for explosives. Dynamite is a mixture of nitroglycerin with an inert filter.

Butyl is prepared commercially by the fermentation of grains and sugars. By using a special strain of micro-

organisms, acetone, and butyl are produced instead of ethanol alcohol. Butyl is used as a solvent for

resins, lacquer, adhesives, and varnishes.

Methanol (sometimes called methyl) is often referred to as wood alcohol because it was once prepared by distillation of wood. Now it is prepared for the most part from petroleum. Methanol is very toxic. It damages the central nervous system and has the most apparent effect on the optic nerve. Both consumption and absorption through the skin can result in poisoning. Although there seems to be several disadvantages, methanol is being looked into as a motor fuel source. All of the cars in the Indianapolis 500 run on methanol. It is easy to produce from natural gas and coal, but has very different properties as a fuel than ethanol. Methanol has a lower boiling point and yields less energy when burned.

Ethanol is the alcohol that is going to run your car. It is also called ethyl or grain alcohol. It is formed by the fermentation of sugars. It is the type of alcohol found in whiskey and other spirits.

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SOME OF THE ADVANTAGES OF ALCOHOL AS A FUEL ARE:

1 Alcohols have a much higher octane rating than many current, unleaded gasolines.

2 Alcohol with water has little effect on engine operation.

3 Alcohols can be burned leaner. This means a high ratio of air to fuel. The result is no air pollutants (such as carbon monoxide, hydrocarbons and nitrogen) are formed. Thus, no pollution controls are needed.

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Yields Of Alcohol

Part Seven

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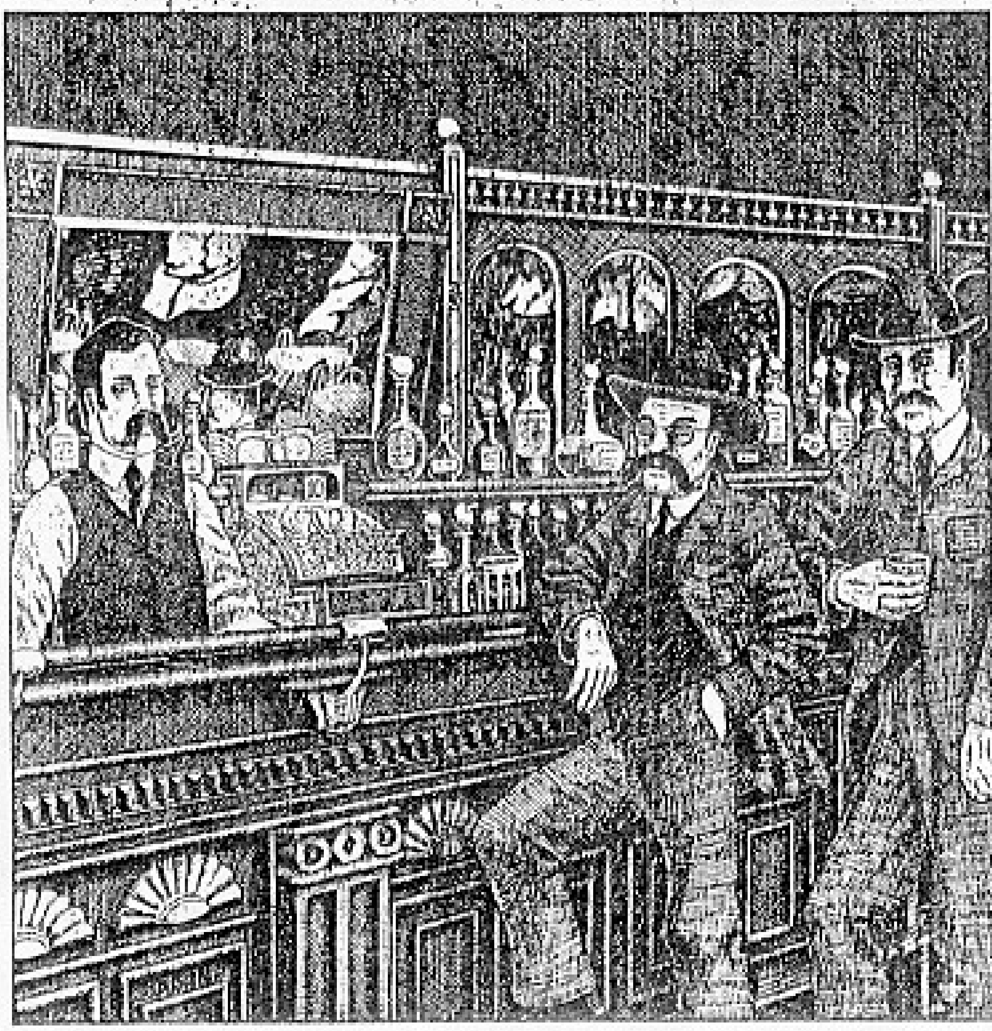
The chart below gives approximate alcohol yields from different raw materials. It was calculated from U.S. Department of Agriculture studies and is based on a 95% alcohol yield. The lower proof yields that we are primarily interested in will raise these figures even higher for each raw material cited.

Raw Material	95% Alcohol Yield
Corn	2.35 gallons per bushel
Wheat	2.4 gallons per bushel
Potatoes	0.69 gallons per bushel
Sweet Potatoes	0.94 gallons per bushel
Sugar Beets	22.1 gallons per TON

BAR DRINKS AND BOOZE LIKE GRANDDAD USED TO MAKE

By Kurt Saxon



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ATLAN FORMULARIES • EUREKA

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NOTE ON MISSING PAGES

The material on liquors from DICK'S ENCYCLOPEDIA OF FORMULAS AND PROCESSES, 1872, which was originally on pages 44 to 81, is now in THE SURVIVOR Vol. 2, pages 806-821.

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TECHNO-CHEMICAL RECEIPT BOOK
1896

SCIENTIFIC AMERICAN CYCLOPEDIA, 1903

No index needed. Subjects and sub-subjects are alphabetized.

THE MIXICOLOGIST

OR

HOW TO MIX ALL KINDS OF FANCY DRINKS

1897

CONTAINING CLEAR AND RELIABLE DIRECTIONS FOR MIXING ALL THE DIFFERENT BEVERAGES USED IN THE UNITED STATES, EMBRACING JULEPS, COBBLERS, COCKTAILS, PUNCHES, DURKEES, "RICKEYS," ETC., ETC., IN ENDLESS VARIETY, WITH SOME RECIPES ON COOKING, AND OTHER GENERAL INFORMATION

INTRODUCTORY

THIS is an age of progress. New ideas and new appliances follow each other in rapid succession to meet the ever-increasing demand for novelties, which administer to creature comforts and gratification to fastidious tastes. "The Mixicologist" is intended to meet this demand.

It is with feelings of modesty and diffidence that I approach so important a subject, but my long experience, and my hearty desire to produce what I hope will become a standard, and thus to help my fellow workers, and also to elevate the tone of our profession, prompts the undertaking.

These, I trust, are sufficient reasons for my attempting to write the following. If to "tend bar" consisted only in filling up glasses thoughtlessly, and pushing them out to customers carelessly, it would not be proper to speak of it as a polite vocation and a fine art, and it would be useless to write on the subject. But I place it among the more elegant employments of life, and to be a successful bartender requires the exercise of those finer faculties that distinguish the cultured artist from the inexperienced, and which are so much appreciated by gentlemen customers.

In this introductory I feel it my duty to thank my friends for information received for this book, also for hints and suggestions as to how to distribute the same, and I feel satisfied that I now have produced a standard work, having spent much time and labor in revising same. Recipes, etc., will be readily found by consulting the index.

Respectfully,

THE AUTHOR.

"Touch brim! touch foot! the wine is red,
And leaps to the lips of the free;
Our wassail true is quickly said—
Comrade! I drink to thee!

"Touch foot! touch brim! who cares? who cares?
Brothers in sorrow or glee;
Glory or danger each gallantly shares—
Comrade! I drink to thee!

"Touch brim! touch foot! once again, old friend,
Though the present our last draught be;
We were boys—we are men—we'll be true to the
Brother! I drink to thee!"

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THE MIXICOLOGIST,

OR,

HOW TO MIX ALL DRINKS.

Whiskey Cocktail.

(Use medium-size glass.)

Fill glass two thirds full of fine ice; small barspoonful of syrup; two dashes Angostura bitters. 1 jigger whiskey. Stir well; strain in cooled cocktail-glass; squeeze the oil from a piece lemon-peel on top fruit if desired.

Improved Whiskey Cocktail.

Prepared in the same manner as the Improved Brandy Cocktail, by substituting rye or bourbon whiskey for the brandy.

Brandy Cocktail.

(Use small barglass.)

Take 2 dashes syrup.
2 dashes Angostura bitters.
1 jigger brandy.

Fill the glass two thirds full shaved ice, stir, and strain into cool glass with fruit in season.

Manhattan Cocktail.

(Medium-size glass.)

Take 1 dash Angostura bitters.
1 half barspoonful syrup.
1 half jigger vermouth.
1 half jigger whiskey.
2 dashes of maraschino.

Stir well in glass previously filled with fine ice; strain in cool cocktail-glass.

Improved Brandy Cocktail.

(Use ordinary barglass.)

Take 2 dashes Angostura.
2 dashes gum syrup.
2 dashes maraschino
1 dash absinthe.
⅚ jigger brandy.

Stir well, and strain with fruit and twisted lemon-peel in a cool champagne-glass.

Martinez Cocktail.

(Use medium-size glass.)

Take 2 dashes orange bitters.
1 dash syrup.
½ jigger Old Tom gin.
½ jigger vermouth.

Stir well, and strain into cocktail glass; add one imported cherry.

Vermouth Cocktail.

(Use large barglass.)

Fill glass two thirds full fine ice.
Take 2 dashes maraschino.
2 dashes Angostura bitters.
1 jigger vermouth

Stir, and strain into cocktail-glass; fruit if desired.

Absinthe Cocktail.

(Use medium-size glass.)

Fill glass nearly full fine ice; cool off claret-glass while preparing.
Take 2 dashes Angostura bitters.
2 dashes anisette.
⅔ jigger absinthe.

Add a little water; stir well, and strain into claret-glass.

Improved Tom Gin Cocktail.

(Use medium-size glass.)

Fill with fine ice.
Take 1 dash Curaçoa.
2 dashes bitters (some preferring orange only).
1 jigger Old Tom.

Stir well, and strain in cool cocktail-glass.

Wachholderbeeren Hahnschwanz.

Prepared in same manner, using two dashes syrup instead of Curaçoa and Holland gin.

Coffee Cocktail.

(Use large barglass.)

Fill two thirds full ice.
1 spoonful sugar.
1 egg.
½ jigger sherry.
½ jigger port.

Shake thoroughly, and strain, with nutmeg on toj

Trilby Cocktail.

(Use medium-size glass.)

Fill with shaved ice.

2 dashes raspberry syrup.
⅓ jigger vermouth.
⅔ fine brandy.
1 dash orange bitters.

Stir well, and strain into tall, fancy glass, with fruit in season.

Soda Cocktail.

(Use large soda-glass.)

Take 1 barspoonful sugar.
2 dashes Boker's or Angostura bitters.
3 lumps ice (not fine).
1 bottle soda plain (or lemon).

Serve in same glass, with spoon.

St. Petersburg Cocktail.

Fill glass with fine ice, using medium-size thin glass or goblet; then empty out ice; now fill with sugar, empty again; now put in two lumps ice, two thirds jigger brandy, piece twisted lemon-peel; fill up with champagne.

Morning Cocktail.

(Use medium-size glass.)

Take 3 dashes syrup.
2 dashes Curaçoa.
2 dashes Angostura or Boker's bitters.
1 dash absinthe.
1 pony brandy.
1 pony whiskey.

Stir well, and strain into long, thin glass, filling it up with fresh apollinaris, and stir with a spoon having a little sugar in it.

Hendrick Cocktail.

(Use old-fashioned toddy glass.)

Fill two thirds full ice
Take 2 dashes syrup.
2 dashes bitters.
1 dash absinthe.
1 jigger old Kentucky bourbon.
1 small slice lemon.

Stir, and serve in the same glass without straining.

John Collins.

Put in mixing-glass one half lemon with peel on; one spoonful sugar; muddle well; fill glass two thirds full of shaved ice, one jigger Old Tom gin; shake well; strain in thin lemonade-glass; fill with club soda; stir.

Irish Cocktail.

(Use large glass.)

Take 1 lump ice.
2 drops Angostura or Boker's bitters.
½ naggin Irish whiskey.
1 bottle C. & C. ginger ale.

This is a very palatable drink, and is the favorite of the Irish members of Parliament.

Dutch Cocktail.

(Use large goblet.)

One third full of beer.
One bottle ordinary mineral water.

This is a very good drink for stopping thirst. It is universally known.

Chocolate Cocktail.

(Use large lemonade glass.)

Fill with ice.
Take 1 barspoonful of sugar.
1 egg.
½ jigger mariaschino.
½ jigger chartreuse.

Shake well, and strain in cocktail-glass.

Durkee.

(Use large glass.)

Put in mixing-glass one lemon with peel on; one spoonful sugar; muddle well; fill two thirds full fine ice, one jigger Jamaica rum, one pony Curaçoa; fill with club soda; carefully stir and strain. This will serve for two split.

K and K Punch.

Put in mixing-glass one barspoonful sugar, one quarter lemon with peel on; muddle well; fill two thirds full of fine ice, one jigger whiskey; fill with Apollinaris; stir with spoon thoroughly; strain in ale-glass previously cooled; add fruit.

Rickey.

Take nice thin goblet, one lump ice, squeeze juice of one good-sized lime or two small ones, one jigger Old Tom Gin. Fill up with Club soda, stir, and serve with spoon in goblet.

Old-fashioned Cocktail.

Crush in small barglass one lump loaf sugar, put in two dashes Angostura bitters, one piece twisted lemon-peel, two or three small lumps of ice, one jigger whiskey. Serve with small barspoon in glass.

Strained Toddy.

Put in mixing glass one barspoonful sugar, one quarter lemon with peel on; muddle; fill glass two thirds full of shaved ice, one jigger whiskey, one jigger water, stir well, strain in star champagne-glass, nutmeg on top.

A Reviver.

Put three or four lumps of ice in lemonade-glass, one jigger raspberry syrup, one wineglass milk, one pony brandy; fill glass with sweet soda.

Stone Fence.

Serve the same as plain whiskey, substituting cider for water on the side.

Punch a la Dwyer.

In punchbowl put—

1 dozen lumps cut loaf sugar.
1 lemon sliced.
1 orange sliced thin.
1 quart Burgundy.
2 jiggers 1835 Cognac.
1 quart Apollinaris.
1 quart champagne.
1 large lump ice.

Stir together; serve.

Seltzer Lemonade.

Put 1 peeled lemon, cut in two, in large mixing glass, 1 large barspoonful sugar, muddle thoroughly, fill half full of ice, fill with Seltzer, stir with spoon, strain in thin glass, add fruit.

Milk Punch.

Fill large mixing-glass half full of ice.

Take 1 large spoonful of sugar.
1 jigger brandy.
4 or 5 dashes rum.

Fill the glass with milk, shake well, strain in tall, thin lemonade-glass, nutmeg on top.

Brandy and Mint.

Put in small barglass 1 lump cut loaf-sugar, dissolve in water.

Take 1 sprig mint, bruised slightly.
2 lumps ice.
1 jigger brandy.

Serve with small barspoon in glass; ice water on side.

Brandy and Ginger Ale.

Put in thin lemonade-glass
1 jigger brandy.
1 lump ice.

Fill with imported ginger ale; serve.

Absinthe Frappe.

Fill mixing-glass with fine ice, one jigger absinthe, a few drops anisette; shake well, strain in claret-glass and fill with Seltzer.

Champagne Cup.

Mix in punchbowl
1 quart champagne.
1 bottle club soda.
1 pony glass Curaçoa.
2 slices cucumber rind.
A few strawberries, if in season.
3 or 4 slices pineapple.

Serve in star champagne-glasses.

Port Wine Sangaree.

Fill mixing-glass half full of fine ice.
1 barspoonful sugar.
1 piece lemon-peel.
1 jigger port wine.

Shake well, strain in star champagne-glass, nutmeg on top.

Whiskey, brandy, and gin in the same manner.

Half and Half. (Dublin Style.)

Fill ale-glass one half with ale and the other with stout.

Dripped Absinthe.

Put pony-glass in mixing-glass, fill around with fine ice, fill pony with absinthe, drip about two jiggers water through drip in absinthe, running over the sides of pony; then take out pony and stir; strain in port-wine glass.

Whiskey and Glycerine.

Half tablespoonful pure glycerine, one jigger of whiskey. This is a most excellent remedy for a cold or any disease of the throat or lungs. When possible, it should be taken a spoonful at a time at intervals of a half hour, letting it trickle down the throat. If the taste is not agreeable, a teaspoonful of wintergreen essence will make it palatable.

Claret Flip.

Fill mixing-glass two thirds full of fine ice, large barspoonful sugar, two jiggers claret, one egg; shake well, strain in star champagne glass, nutmeg on top.

Wedding Punch.

Take ½ pint of pineapple juice.
1 pint of lemon juice.
1 pint of lemon syrup.
1 pint of claret or port wine.
½ pound of sugar.
½ pint of boiling water.
6 grains of vanilla.
1 grain of ambergris.
1 pint of strong brandy.

Rub the vanilla and ambergris with the sugar in the brandy thoroughly; let it stand in a corked bottle for a few hours, shaking occasionally. Then add the lemon juice, pineapple juice and wine; filter through flannel, and lastly add the syrup.

Tea Punch.

(Use heated metal bowl.)

Take ½ pint of good brandy.
½ pint of rum.
¼ pound of loaf-sugar, dissolved in water.
1 ounce of best green tea.
1 quart of boiling water.
1 large lemon.

Infuse the tea in the water. Warm a silver or other metal bowl until quite hot; place in it the brandy, rum, sugar, and the juice of the lemon. The oil of the lemon peel should be first obtained by rubbing with a few lumps of the sugar. Set the contents of the bowl on fire; and while flaming, pour in the tea gradually, stirring with a ladle. It will continue to burn for some time, and should be ladled into glasses while in that condition. A heated metal bowl will cause the punch to burn longer than if a china bowl is used.

Punch a la Romaine.

(For a party of fifteen.)

Take 1 bottle of rum.
1 bottle of wine.
10 lemons.
2 sweet oranges.
2 pounds of powdered sugar.
10 eggs.

Dissolve the sugar in the juice of the lemons and oranges, adding the thin rind of one orange; strain through a sieve into a bowl, and add by degrees the whites of the eggs beaten to a froth. Place the bowl on ice for a while, then stir in briskly the rum and the wine.

Duke of Norfolk Punch.

(For bottling.)

Take 2 quarts of brandy.
1 quart of white wine.
1 quart of milk.
1¼ pounds of sugar.
6 lemons.
3 oranges.

Pare off the peel of the oranges and lemons very thin; put the peel and all the juice into a vessel with a close-fitting lid. Pour on the brandy, wine and milk, and add the sugar after having dissolved in sufficient water. Mix well, and cover close for twenty-four hours. Strain until clear, and bottle.

PUNCH.

The origin of this word is attributed by Dr. Doran, in his "History of Court Fools," to a club of Athenian wits; but how he could possibly connect the word Punch with these worthies, or derive it from either their sayings or doings, we are totally at a loss to understand. Its more probable derivation is from the Persian Punj, or from the Sanscrit Pancha, which denotes the usual number of ingredients of which it is composed, viz., five. The recipes, however, for making this beverage are very numerous, and, from various flavoring matters which may be added to it, Punch has received a host of names derived alike from men or materials.

B. & S.

(Use medium thin barglass.)

Take 1 pony glass of brandy.
1 small lump of ice.

Add one bottle of plain soda water. This bottle of soda will do for two split.

Brandy and Gum.

(Use small barglass.)

Take 2 dashes of gum syrup.
1 small lump of ice.

Hand the bottle to the customer and let him help himself.

Serve ice water in a separate glass.

Sherry Cobbler.

(Use large barglass.)

Take 1 tablespoonful powdered sugar.
1 slice orange cut in 2 parts.
Dissolve sugar.

Fill the glass with shaved ice, then fill it up with sherry wine; stir it carefully, ornament the top with pineapple and berries and serve with straws.

Champagne Cobbler.

(Use bottle of wine to four large barglasses.)

Put in tall, thin glass two lumps sugar, one slice orange, one piece twisted lemon peel, fill two thirds full shaved ice, fill balance with wine; stir moderately, ornament in a tasty manner, and serve with straws.

Claret Cup.

Take 1 bottle of claret.
little water.
1 tablespoonful of powdered sugar.
1 teaspoonful of powdered cinnamon, cloves, and allspice, mixed.
½ lemon.
1 bottle soda.

Mix the ingredients well together, adding the thin rind of cucumber and some mint, not pressed. This is a nice summer beverage for evening parties.

Porter Cup.

Take 1 bottle of porter.
1 bottle of ale.
1 glass of brandy.
1 dessertspoonful of syrup of ginger.
3 or 4 lumps of sugar.
½ nutmeg, grated.
1 teaspoonful carbonate of soda.
1 cucumber.

Mix the porter and ale in a covered jug; add the brandy, syrup of ginger, and nutmeg; cover it, and expose it to the cold for half an hour. When serving, put in the carbonate of soda.

Sherry Cocktail.

(Use small mixing-glass.)

Made in same manner as whiskey, only using Amontillada sherry.

Curacoa Punch.

(Use large barglass.)

Take one tablespoonful of powdered white sugar, dissolved in a little water.
1 wineglass of brandy.
¼ wineglass of Jamaica rum.
½ pony-glass of Curaçoa.
the juice of half a lemon.

Fill the tumbler with shaved ice, shake well, and ornament with fruits of the season. Serve with a straw.

Roman Punch.

(Use large barglass.)

Take one tablespoonful of powdered white sugar, dissolved in a little water.
1 tablespoonful of raspberry syrup.
1 teaspoonful of Curaçoa.
1 wineglass of Jamaica rum.
½ wineglass of brandy.
the juice of half a lemon.

Fill with shaved ice, shake well, dash with port wine, and ornament with fruits in season. Serve with a straw.

Burnt Brandy.

Put 1 lump sugar in saucer.
1 jigger brandy.

Light it with a match, let it burn for a minute or so, extinguish the flame, put in whiskey-glass and serve.

Champagne Punch.

(One quart of punch.)

Take 1 quart bottle of champagne wine.
3 tablespoonfuls of sugar.
1 orange, sliced.
the juice of a lemon.
2 slices of pineapple, cut in small pieces.
1 wineglass of raspberry or strawberry syrup.

Ornament with fruits in season, and serve in champagne goblets.

This can be made in any quantity by observing the proportions of the ingredients as given above. Four bottles of wine make a gallon, and a gallon is generally sufficient for fifteen persons in a mixed party.

Tom Gin Cocktail.

Fill mixing-glass two thirds full of shaved ice.
1 or 2 dashes orange bitters.
1 barspoonful syrup.
1 jigger Tom gin.

Stir and strain in cooled cocktail-glass, twist a piece of lemon-peel over the top to flavor, serve fruit if desired.

Golden Fizz.

Same as Silver Fizz, using the yolk in place of the white of an egg.

Bear in mind all fizzes and similar drinks must be taken while effervescing or they lose their natural taste.

Brandy Fizz.

(Use medium barglass.)

Take 1 teaspoonful of powdered sugar.
3 dashes of lemon juice.
1 wineglass of brandy.
Fill with ice, shake well and strain.
Fill up the glass with Apollinaris or Seltzer water.

Gin Fizz.

(Use medium barglass.)

Take 1 teaspoonful of powdered sugar.
3 dashes of lemon juice.
1 wineglass of Old Tom gin.
Fill with ice, shake well and strain.

Fill up the glass with Apollinaris or Seltzer water, stir thoroughly and serve.

Silver Fizz.

(Use large barglass.)

Take 1 tablespoonful of pulverized sugar.
3 dashes of lemon or lime juice.
The white of one egg.
1 wineglass of Old Tom gin.
2 or 3 small lumps of ice.

Shake up thoroughly, strain into a medium barglass, and fill it up with Seltzer water.

Manhattan Milk Punch.

Same as the *Cold* Milk Punch, with the addition of five drops of aromatic tincture.

Milk Punch.

(Use large barglass.)

Take 1 desertspoonful of fine sugar.
1 wineglass of brandy.
½ wineglass Santa Cruz rum.
½ glass fine ice.

Fill with milk, shake the ingredients well together, strain into a large glass, and gra'e a little nutmeg on top.

Hot Milk Punch.

(Use large barglass.)

This punch is made the same as the above, with the exception that hot milk is used, and no ice.

Whiskey Sour.

(Use small barglass.)

Take one large teaspoonful of powdered white sugar, dissolved in a little Seltzer or Apollinaris water.
The juice of half a small lemon.
1 wineglass of bourbon or rye whiskey.

Fill the glass full of shaved ice, shake up and strain into a claret glass. Ornament with berries.

Brandy Sour.

(Use small barglass.)

Take one large teaspoonful of powdered white sugar, dissolved in a little Apollinaris or seltzer water.
The juice of half a lemon.
1 dash of Curaçoa.
1 wineglass of brandy.

Fill the glass with shaved ice, shake, and strain into a claret-glass. Ornament with orange and berries.

Egg Sour.

(Use small barglass.)

Take 1 teaspoonful of powdered sugar.
3 dashes of lemon juice.
1 pony of Curaçoa.
1 pony of brandy.
1 egg.
2 or 3 small lumps of ice.

Shake up well, and remove the ice before serving.

Apple Toddy.

(Use medium barglass, hot.)

Take 1 large teaspoonful of fine sugar dissolved in a little boiling-hot water
1 wineglass of brandy (applejack).
½ of a baked apple.

Fill the glass two thirds full of boiling water, stir up, and grate a little nutmeg on top. Serve with a spoon.

Pousse l'Amour.

(Use a sherry-glass.)

Take ½ glass of maraschino.
Yolk of 1 egg.
Sufficient vanilla cordial to surround the egg.
1 tablespoonful of fine old brandy.

First; pour in the maraschino, then introduce the yolk with a spoon, without disturbing the maraschino; next carefully surround the egg with vanilla cordial, and lastly put the brandy on top.

In making a Pousse of any kind the greatest care should be observed to keep all the ingredients composing it separate. This may best be accomplished by pouring the different materials from a sherry-wine glass. It requires a steady hand and careful manipulation to succeed in making a perfect Pousse.

Lawlor's Pousse Cafe.

(Use a small wineglass.)

Take ¼ Curaçoa.
¼ maraschino.
¼ yellow chartreuse.
¼ old Cognac brandy.

Keep all the ingredients separate. **See concluding remarks in the preceding recipe.**

Parisian Pousse Cafe.

(Use small wineglass.)

Take ⅖ Curaçoa.
⅖ Kirschwasser.
⅕ chartreuse.

Care should be taken to keep the ingredients from mixing together. See preceding recipes.

Hot Whiskey Sling.

(Use medium barglass, hot.)

Take 1 small teaspoonful of powdered sugar.
1 wineglass of bourbon or rye whiskey.

Dissolve the sugar in a little hot water, add the whiskey, and fill the glass two thirds full of boiling water; grate a little nutmeg on top and serve.

Hot Spiced Rum.

(Use medium barglass, hot.)

Take 1 small teaspoonful of powdered white sugar.
1 wineglass of Jamaica rum.
1 teaspoonful of spices (allspice and cloves, not ground).
1 piece of sweet butter as large as half a chestnut.

Dissolve the sugar in a little boiling water, add the rum, spices, and butter, and fill the glass two thirds full of boiling water.

Hot Rum.

(Use medium barglass, hot.)

Take 1 lump of cut sugar.
1 wineglass of Jamaica rum.
1 piece of sweet butter as large as half a chestnut.

Dissolve the sugar in a little boiling water, add the rum and butter, fill the glass two thirds full of boiling water, stir, grate a little nutmeg on top, and serve.

Eggnog.

(Use large barglass.)

Take 1 large teaspoonful of powdered sugar.
1 fresh egg.
½ wineglass of brandy.
½ wineglass of Santa Cruz rum.
A little shaved ice.

Fill the glass with rich milk, and shake up the ingredients until they are thoroughly mixed. Pour the mixture into a goblet, excluding the ice, and grate a little nutmeg on top. This may be made by using a wineglass of either of the above liquors, instead of both combined.

Hot Eggnog.

(Use large barglass.)

This drink is very popular in California, and is made in precisely the same manner as the cold egg-nog above, except that you must use boiling water instead of ice.

Claret Punch.

(Use good-sized glass.)

Nearly fill with claret.
1 piece of lemon peel.

Put in thin lemonade-glass one large spoonful sugar, sufficient water to dissolve; fill half full of fine ice; stir well, trim with fruits, serve with straws

Brandy Punch.

(Use large barglass.)

Take 1 teaspoonful of powdered sugar, dissolved in a little water.*
1 wineglass of brandy.
½ wineglass of Jamaica rum.
Juice of half a lemon.
2 slices of orange.
1 piece of pineapple.

Fill the tumbler with shaved ice; shake up thoroughly, and dress the top with berries in season; serve with a straw.

Brandy and Rum Punch.

(Use large barglass.)

Take 1 tablespoonful of powdered sugar, dissolved in a little water.
1 wineglass of Santa Cruz rum.
½ wineglass of brandy.
Juice of half a small lemon.
1 slice of orange (cut in quarters.)
1 piece of pineapple.

Fill the tumbler with shaved ice; shake well, and dress the top with sliced lime and berries in season; serve with a straw.

Hot Brandy.

In hot whiskey-glass put one lump cut-loaf sugar, enough hot water to dissolve, one jigger brandy; fill glass to within half an inch of the top with hot water, nutmeg on top; serve with spoon in glass

Hot Irish Whiskey Punch.

(Use medium barglass.)

Take 1 wineglass Irish whiskey.
2 wineglasses of boiling water.
2 lumps of loaf-sugar.

Dissolve the sugar well with one wineglass of the water, then pour in the whiskey, add the balance of the water, and put in a small piece of lemon peel. Before using the glass rinse it in hot water.

Hot Scotch Whiskey Punch.

(Use medium barglass.)

Take 1 wineglass of Glenlivet or Islay whiskey.
2 wineglasses of boiling water.
Sugar to taste.

Dissolve the sugar with one wineglass of the water, then pour in the whiskey, add the balance of the water, and put in a small piece of lemon peel. Before using the glass rinse it in hot water.

Brandy Fix.

Put in thin lemonade-glass small barspoonful sugar, enough water to dissolve; fill half full of ice, juice one quarter lemon, four dashes pineapple syrup, one jigger brandy; stir well, fill glass full of ice, trim with seasonable fruits; serve with straws.

Champagne Cocktail—(Plain.)

Put one lump cut-loaf sugar in small, thin lemonade-glass, one or two dashes Angostura bitters, one piece twisted lemon peel; put two or three small lumps of ice; fill with champagne; stir gently; serve.

Champagne Julep.

Use thin lemonade-glass, one lump cut-loaf sugar, two or three small lumps of ice, two sprigs mint bruised slightly; pour in the champagne slowly; stir gently until full; add seasonable fruits; serve.

Brandy Sour.

Fill mixing-glass two thirds full of fine ice, juice one quarter lemon, one dash Jamaica rum, one large spoonful sugar; shake well; strain in punch-glass; add fruit. Use seven-eighths jigger brandy.

Brandy Flip.

Fill mixing-glass two thirds full of fine ice, one barspoonful sugar, one jigger brandy, one egg; shake well; strain in star champagne-glass, nutmeg on top; serve.

Brandy and Soda.

Put two or three lumps ice in thin lemonade-glass, one jigger brandy; pour in one bottle of club soda.

Splificator.

(Use medium thin glass.)

One piece ice; let customer help himself to whiskey, and fill up with Apollinaris water.

Buffalo.

(Use small goblet.)

And serve same as the foregoing recipe.

Brandy Sangaree.

(Use medium barglass.)

Take ½ teaspoonful of fine white sugar dissolved in a little water.
1 wineglass of brandy.

Fill the glass one third full of shaved ice, shake up well, strain into a small glass and dash a little Port wine on top. Serve with a little grated nutmeg.

Whiskey Sangaree.

(Use medium barglass.)

Same as brandy sangaree, only using rye or bourbon whiskey instead of the brandy.

Gin Sangaree

Same as brandy or whiskey sangaree, substituting Holland or Old Tom gin instead of brandy or whiskey.

Brandy Smash.

(Use small barglass.)

Take 1 barspoonful of sugar.
2 tablespoonfuls of water.
3 or 4 sprigs of tender mint.
1 wineglass full of brandy.

Press the mint in the sugar and water to extract the flavor, add the brandy, and fill the glass two thirds full of shaved ice; stir thoroughly, and ornament with half a slice of orange and a few fresh sprigs of mint; serve with a straw.

Gin Smash.

(Use small barglass.)

Take 1 barspoonful of sugar.
2 teaspoonfuls of water.
1 wineglass of gin.
3 or 4 sprigs of tender mint.

Put the mint in the glass, then the sugar and water; mash the mint to extract the flavor; add

the gin, and fill up the glass with shaved ice; stir up well, and ornament with two or three fresh sprigs of mint.

Whiskey Smash.

(Use small barglass)

Take 1 barspoonful of sugar.
2 teaspoonfuls of water.
3 or 4 sprigs of young mint.
1 wineglass of whiskey.
Proceed exactly as directed in the last recipe.

To Frappe Champagne.

Place the bottle in the champagne pail, fill with fine ice and salt; whirl or twist the bottle several times, and it will become almost frozen.

High Ball (or Bradley Martin).

Put in thin ale-glass one lump of ice; fill with syphon seltzer to within an inch of the top, then float one half jigger Cognac brandy or Rye whiskey.

Whiskey and Mint.

Put in barglass one lump cut-loaf sugar, enough water to dissolve, one or two sprigs mint; mash sugar and mint together; serve same as plain whiskey, leaving barspoon in glass.

Gin Crust.

(Use small barglass.)

Gin crust is made like the brandy crust, using gin instead of brandy.

Brandy Daisy.

(Use small barglass.)

Take 3 or 4 dashes of gum syrup.
2 or 3 dashes of Curaçoa cordial.
The juice of half a small lemon.
1 small wineglass of brandy.
2 dashes of Jamaica rum.
Fill glass one third full of shaved ice.
Shake well, strain into a large cocktail-glass, and fill up with Seltzer water from a syphon.

Whiskey Daisy.

(Use small barglass.)

Take 3 dashes of gum syrup.
2 dashes syrup.
The juice of half a small lemon.
1 wineglass of bourbon or rye whiskey.
Fill glass one third full of shaved ice.
Shake well, strain into a large cocktail-glass, and fill up with Seltzer, Apollinaris or Imperial water.

Gin Daisy.

In same manner as whiskey, only using gin.

Beef Tea.

Put a barspoonful of the extract in a hot cup; add salt, pepper and celery salt; fill the cup with hot water, stir well, adding a few drops Worcestershire sauce and a few drops of old sherry. Serve with fine ice in glass on side.

Remsen Cooler.

Pare the rind from a lemon, leaving the rind whole; put it in a large punch-glass with two or three small lumps ice and a jigger Old Tom gin; fill up with plain soda.

Big 4 Mint Julep.

(Use large thin glass.)

Put some mint in glass; add a barspoonful powdered sugar; dissolve; don't crush the mint; put in some fine ice, one and a quarter jigger fine old whiskey; stir, and fill up with ice to top of glass; now place two nice sprigs of mint in glass, decorate with fruit, and lastly, a dash of St. Croix rum on top; sprinkle a little sugar on mint and serve with straws.

Gin Julep.

(Use large barglass.)

The gin julep is made with the same ingredients as the mint julep, omitting the fancy fixings.

Whiskey Julep.

(Use large barglass.)

The whiskey julep is made the same as the mint julep, omitting all fruits and berries.

Pineapple Julep.

(For a party of five.)

Take the juice of two oranges.
1 gill of raspberry syrup.
1 gill of Maraschino.
1 gill of Old Tom gin.
1 quart bottle of sparkling Moselle.
1 ripe pineapple, peeled, sliced, and cut up.
Put all the materials in a glass bowl; ice, and serve in flat glasses, ornamented with berries in season.

Brandy Julep.

Same as Big 4, using good brandy instead whiskey.

Tom and Jerry.

(Use punch-bowl for the mixture.)

Take 12 fresh eggs.
½ small barglass of Jamaica rum.
1½ teaspoonfuls of ground cinnamon.
½ teaspoonful of ground cloves.
½ teaspoonful of ground allspice.
Sufficient fine white sugar.

Beat the whites of the eggs to a stiff froth, and the yolks until they are as thin as water; then mix together, and add the spice and rum; stir up thoroughly, and thicken with sugar until the mixture attains the consistence of a light batter.

How to Serve Tom and Jerry.

(Use T. and J. Mug)

Take 1 desertspoonful of the above mixture.
1 wineglass of brandy or whiskey.

Fill the glass with boiling water, grate a little nutmeg on top, and serve with a spoon.

Hot English Rum Flip.

(One quart.)

Take 1 quart of ale.
1 gill of old rum.
4 raw fresh eggs.
4 ounces of moist sugar.

Heat the ale in a sausepan; beat up the eggs and sugar, add the nutmeg and rum, and put it all in a pitcher. When the ale is near to a boil, put it in another pitcher; pour it very gradually in the pitcher containing the eggs, etc., stirring all the while very briskly to prevent the eggs from curdling; then pour the contents of the two pitchers from one to the other until the mixture is as smooth as cream.

Hot English Ale Flip.

(One quart.)

This is prepared in the same manner as the Rum Flip, omitting the rum and the whites of two of the eggs.

Sleeper.

Take 1 gill of old rum.
1 ounce of sugar.
2 raw fresh eggs.
½ pint of water.
Mix well.

Port Wine Flip.

(Use large barglass.)

Take 1 barspoonful of powdered sugar.
1 large wineglass of Port wine.
1 fresh egg.
Glass two thirds full of ice.

Break the egg into the glass, add the sugar, and lastly the wine and ice. Shake up thoroughly, and strain into a medium-sized goblet; nutmeg on top.

Sherry Wine Flip.

(Use large barglass.)

This is made precisely as the Port wine flip, substituting sherry wine instead of Port.

Sherry and Bitters.

(Use sherry wineglass.)

Take one dash of Angostura bitters, twist the glass around so that the bitters will cover the whole surface of the glass. Fill with sherry wine and serve.

Sherry and Egg.

(Use small barglass.)

Pour in glass a little sherry. Break in the glass one fresh egg. Then fill with sherry.

Sherry and Ice.

(Use small barglass.)

Put in the glass two or three small lumps of ice. Place the decanter of wine before customer.

Catawba Cobbler.

(Use large barglass.)

Take 2 teaspoonfuls of fine white sugar, dissolved in a little water.
1 slice of orange cut into quarters.

Fill the glass half full of shaved ice, then fill it up with catawba wine. Ornament the top with berries in season, and serve with straws.

Hock Cobbler.

(Use large barglass.)

This drink is made the same way as the catawba cobbler, using Hock wine instead of catawba.

Claret Cobbler.

(Use large barglass.)

This drink is made the same way as the catawba cobbler, using claret wine instead of catawba, and is a very refreshing drink.

Sauterne Cobbler.

(Use large barglass.)

The same as catawba cobbler, using sauterne instead of catawba.

Rhine Wine Cobbler.

(Use large barglass.)

The same as catawba using Rhine wine.

Brandy Crust.

(Use small barglass.)

Take 3 or 4 dashes of gum syrup.
1 dash of Angostura bitters.
1 wineglass of brandy.
2 dashes of curaçoa.
1 dash lemon juice.

Before mixing the above ingredients prepare cocktail-glass as follows:

Rub a sliced lemon around the rim of the glass, and dip it in pulverized white sugar, so that the sugar will adhere to the edge of the glass; pare half a lemon the same as you would an apple (all in one piece) so that the paring will fit in the wineglass; put the above ingredients into a small whiskey-glass filled one third full of shaved ice; shake up well, and strain the liquid into the cocktail-glass, prepared as above directed.

Whiskey Crust.

(Use small barglass.)

The whiskey crust is made in the same manner as the brandy crust, using whiskey instead of brandy.

Shandy Gaff.

(Use large barglass, or mug.)

Fill the glass half full of ale, and the remaining half with Irish ginger ale.

In England, where this drink had its origin, it is made with Bass' ale and ginger ale, half and half.

Half and Half.

(Use metal or stone barmug.)

Mix half old and half new ale together.

This is the American method.

"'Arf and 'Arf."

(Use metal or stone barmug.)

Mix porter or stout with ale in equal quantities, or in proportions to suit the taste.

This is the English method, and usually "draw it mild, Mary; the ale first."

Bishop.

(Use large soda-glass,)

Take 1 teaspoonful of powdered white sugar dissolved in 1 wineglass of water.
2 thin slices of lemon.
2 dashes of Jamaica rum.
2 or three small lumps of ice.

Fill the glass with claret or red Burgundy; shake up well, and remove the ice before serving.

English Bishop.

(To make one quart.)

Take 1 quart of Port wine.
1 orange (stuck pretty well with cloves, the quantity being a matter of taste).

Roast the orange before a fire, and when sufficiently brown, cut it in quarters, and pour over it a quart of Port wine (previously made hot), add sugar to taste, and let the mixture simmer over the fire for half an hour.

White Plush.

(Use small barglass.)

Hand a bottle of bourbon or rye whiskey to the customer and let him help himself. Fill up the glass with fresh milk.

A curious story about the origin of this drink is thus told by the New York *Herald:*

"There are some mixed drinks that are standbys, and are always popular, such as cocktails, punches, and juleps; but every little while there will be a new racket sprung on the public that will have a great run for a time, and then get knocked out by another. About a month ago white plush got its start in this way: There was a country buyer down from New England somewhere, and a party of dry goods men were trying to make it pleasant for him. So they took him into a swell barroom down town, and were going to open sour wine. Same old story, you know; get him full as a balloon and then work him for a big order. It turned out that this countryman was not such a flat as they thought him. Though he had been swigging barrels of hard cider and smuggled Canada whiskey for the last twenty years, he pleaded the temperance business on them; said he never drank, and he guessed he'd just take a glass of water if they'd git him one, as he was

kinder thirsty walkin' round so much. Well, that was a set-back for the boys. They knew he had lots of money to spend, and he was one of those unapproachable ducks that have got to be warmed up before you can do anything with them.

"'Oh, take something,' they said; 'take some milk.'

"'Well, I guess a glass of milk would go sorter good,' said he.

"Some one suggested kumyss, and told him what it was. As they did not have any kumyss in the place they gave him some milk and seltzer. That's about the same thing. One of the boys gave the bartender a wink, and he put a dash of whiskey in it. The old man did not get on to it at all. He thought it was the seltzer that flavored it. The next round the seltzer was left out altogether and more whiskey put in. They kept on giving it to him until he got pretty well set up. It's a very insidious and seductive drink. Pretty soon the countryman got funny and tipped his glass over on the table. As it spread around he said:

"'Gosh, it looks like white plush, don't it?'

"'So it does,' said the boys. 'Give the gentleman anothe. ard of white plush, here;' and the name has stuck to it ever since."

Kentucky Toddy.

Same as old-fashioned toddy, adding little lemon-peel.

Pony Brandy.

To serve pony brandy properly, take whiskey glass, set it on counter top downwards, place pony on top, place 1 small lump ice in a whiskey glass fill pony with only finest Cognac. Customer can take it plain or he will pour it on the icé at his option.

Rhine Wine and Seltzer.

(Use medium thin glass.)

Fill half full or little better of wine, balance Seltzer or Apolinaris. Any still wine in same manner. Ice if wanted, only in lump. Regulate according to customer's desire.

Rock and Rye.

(Use whiskey glass.)

Barspoonful rock candy syrup, small spoon in glass. Let customer help himself to whiskey. This is the best R. and R. Also honey can be used, only dissolving honey well before the liquor is poured in.

Sheridan Punch or Float.

Strain lemonade in thin lemonade-glass to within an inch of top, float over a spoon one half jigger of whiskey on lemonade.

Old-fashioned Toddy.

(Use thick glass.)

One good-sized lump sugar, dissolve with a little water, one lump ice, one jigger whiskey; stir; add nutmeg and serve in same glass.

Benedictine.

Served in the same manner as pony brandy. All Liquers served in same style except pousse-cafe.

Golden Slipper.

Put in bell-shape claret-glass half jigger yellow Chartreuse, yolk of one egg, fill with Kirsch Wasser.

To Serve Champagne.

Place the required number of Champagne-glasses on the bar filled with fine ice; take wine carefully rom the ice and place on bar; remove the wire from the cork with nippers; if corded, be sure and cut all clean from neck of bottle and cork; while doing this do not remove the bottle from the bar; when done, pull the cork about one third out, wipe the lip of the bottle carefully with a clean napkin or towel, throw the ice from the champagne-glasses and draw the cork slowly; pour a little wine in each glass, then commence again with the first and pour as much as you can without having the foam run over the sides; continue this until all the glasses are filled. Always leave the bottle on the bar with the cork by its side or on the top of the bottle until the entire party have finished their wine.

Bowl of Claret Punch.

Four bottles of Claret. Dissolve in sufficient water 3 tablespoonfuls of powdered sugar for each bottle of Claret; slice in two lemons and two oranges, also some pineapple; pour in the claret; mix well, and just before serving put in one quart of domestic Champagne. Serve with square piece of ice in the bowl.

Crème de Menthe.

Fill sherry-glass with fine ice, pour in Creme de Menthe over the ice until glass is full; serve with one straw in glass.

Eggnog in Quantity.

Two and a half gallons. Separate the whites from the yolks of one dozen eggs, whip them separately—the whites until very stiff, the yolks until very thin; put the yolks in large bowl, add three pounds powdered sugar, stirring constantly to prevent sugar from lumping, three pints brandy, one pint Jamaica aum, two gallons rich milk. While stirring put in an ounce of nutmeg. If not strong enough to suit, add more brandy, then put the whites on top. When serving, cut off a small quantity of white and put on top of glass with a dash of nutmeg.

Apple Brandy Cocktail.

Fill mixing glass two thirds full of ice, small barspoonful syrup, two dashes Angostura bitters, three dashes Curaçao, one jigger apple brandy. Stir well; strain in cocktail-glass.

Coffee Cobbler.

(Use large lemonade-glass.)

Fill glass two thirds with ice, one dessert teaspoonful powdered sugar; fill with coffee, stir, then pour in one jigger brandy; stir thoroughly. Serve with a straw. An excellent stimulant.

Tea Cobbler.

(Use large lemonade-glass.)

Made in same manner as Coffee Cobbler, using Irish whiskey instead of brandy, with a thin slice lemon added.

Snow Flake.

(Use thin glass.)

Take large thin glass half filled with sweet milk; fill up with Imperial or seltzer water; both ingredients must be cold.

St. Charles' Punch.

(Use large barglass.)

Take 1 teaspoonful of powdered sugar, dissolved in a little water.

1 wine glass of Port wine.
1 pony glass of brandy.
The juice of quarter of a lemon.

Fill the tumbler with shaved ice, shake well, ornament with fruits in season, and serve with a straw.

La Casino Fizz.

Fill lemonade glass with fine ice to cool it. Put in mixing glass two thirds fine ice, juice one quarter lemon, one barspoonful sugar, three dashes Curaçao, white of one egg; shake well, strain, fill with syphon Seltzer.

Rum Sour.

Fill mixing glass two thirds full of fine ice, juice one quarter lemon, large spoonful syrup, one jigger N. E., Jamaica or St. Croix rum; shake well. Strain in star Champagne-glass with fruit.

An Eye-opener.

In tall, thin glass put one teaspoonful Bromo Seltzer, one jigger Holland or Tom Gin (genuine), fill with club soda; drink while effervescent.

Snow Ball.

Place on the bar a large lemonade glass full of fine ice, putting in a mixing glass one half tablespoonful fine sugar, half jigger whiskey and white of one egg. Fill three fourths with fine ice; shake well and strain into the lemonade glass, after throwing out the ice; then fill with imported ginger ale.

Velvet Gaff.

One pint of Champagne, one pint of Dublin Stout, mixed in a bowl or pitcher. Serve in star Champagne glasses.

Hints on Using Ice.

Great care should be used in handling ice. Do not use the hands. Sometimes a customer asks for more ice. Use spoon or silver scoop. See that your ice is perfectly clean and properly shaved, also having some lumps arranged according to demand for different drinks.

Brandy Toddy.

Fill mixing glass two thirds full of fine ice, large barspoonful syrup, one jigger brandy; stir well and strain into previously cool cocktail glass; add a little nutmeg.

Attorney General.

(Similar to Kentucky Toddy.)

Take good-sized thick glass; two lumps cut

sugar dissolve in a little water, two lumps ice, one jigger Kentucky whiskey (Laingape); stir; add one small slice lemon and little nutmeg. Serve in same glass with spoon.

Ale Sangaree.

(Use thin glass.)

Barspoonful sugar, a few drops lemon, little water to dissolve, one lump ice; pour ale in slowly. Stir carefully, filling up with the ale. Serve with a little nutmeg on top.

Porter Sangaree

(Use thin glass.)

Same as Ale Sangaree, using porter.

Whiskey Punch.

(Use lemonade-glass.)

Take quarter of a lemon, one barspoonful sugar, little water; press the lemon; one jigger bourbon or rye whiskey, fill glass with ice, two dashes rum; shake well and strain into cool stem punch-glass, add fruit. Two or three punches can be made in large glass at the same time, first filling up your stem glasses with ice for as many as required. This is one of the best ways to make a good whiskey punch.

Old-fashioned Punch

(Use medium-sized glass.)

Made with same ingredients as the foregoing, excepting to stir with spoon and serve with the ice in same glass with a strainer or straws.

Whiskey Punch.

(Chicago style.)

Take two same sized mixing glasses, fill with ice, put four dashes syrup, four dashes lemon, one jigger whiskey in one of the mixing glasses; place the other on top, reversing until cold, then strain from both into cool glass, holding them firmly; add fruit.

St. Croix or Jamaica Rum Punch.

In same manner as whiskey punch.

Cazaracino.

Dedicated to

COL. W. B. SMITH,

C. BROWN, NIC. KOSS, AND F. A. BRADLEY.

Make some lemonade, strain into pitcher, then half fill some thin glasses with ice, put in some Cazarac cognac, and fill up with the lemonade.

Bijou Cocktail.

Take ⅓ Grand Marnier.
⅓ Vermouth.
⅓ Plymouth Gin.

Mix and strain; a delicious drink. Grand Marnier can also be served in pony-glass like any liquor.

Swiss S.

Made in same manner as Absinthe Frappe, using white of egg, and well shaken, strained, and filled with seltzer.

Boston Bamboo.

Take ½ Vermouth.
½ sherry.
Bitters and syrup
Stir and strain

Horse's Neck.

(Use large, thin glass.)

Cut the whole of a lemon-peel, in a long string, place into glass, holding one end of peel, filling with ice. Put in two dashes of bitters, bottle of imported ginger ale. Some prefer a jigger of whiskey, filling with seltzer.

Four Nice After-Dinner Drinks.

No. 1. Pony brandy.

No. 2. Brandy and curacoa. Use pony, ½ of each.

No. 3. Creme Dementhe, iced.

No. 4. Pony Grand Marnier. If iced, use sherry glass.

TEMPERANCE DRINKS

Milk and Seltzer.

(Use large soda-glass.)

Fill the glass half full of milk, and the remaining half with seltzer water.

Saratoga Cooler.

(Use large barglass.)

Take 1 teaspoonful of powdered white sugar.
Juice of half a lemon.
1 bottle of ginger ale.
2 small lumps of ice.
Stir well, and remove the ice before serving.

Plain Lemonade.

(Use large barglass.)

Take the juice of half a large lemon.
1½ tablespoonfuls of sugar.
2 or 3 pieces of orange.
Shake, and serve with straws.

Egg Lemonade.

Same as plain, putting in egg only; shake longer.

Soda Cocktail.

Take lemonade-glass two thirds full of ice, one desertspoonful of sugar, two dashes Schroeder's bitters, lemon peel, bottle Trilby soda water; stir, and serve in same glass.

Apollinaris Lemonade.

(Use lemonade-glass.)

Mash one whole lemon, one large spoonful sugar, half fill with ice, fill up with the Apollinaris water; stir, and strain into thin glass, adding fruit.

Seltzer Lemonade.

In same manner as Apollinaris, using Seltzer or Imperial water, the last being a very fine water known as Wagner's Imperial.

Lemonade.

This drink, although simple in name, is very important in first class bars. One good-sized lemon, peeled, cut in half, one and one half large spoonfuls sugar, the lemon well pressed; fill glass two thirds full of ice, fill with water, and shake thoroughly. and strain carefully into thin glass, or serve with straws, adding fruit according to customer's wish. Can be made sour, and with Apollinaris or Seltzer according to order.

Soda Lemonade.

(Use large soda-glass.)

Take 1 tablespoonful of powdered white sugar.
Juice of half a lemon.
1 bottle of plain sodawater.
2 or 3 small lumps of ice.
Stir up well, and serve with straws or strait.

SELTZER LEMONADE may be made by substituting Seltzer water for the soda.

Egg Lemonade.

(Use large barglass.)

Take 1 large tablespoonful of pulverized white sugar.
Juice of half a lemon.
1 fresh egg.
2 or 3 small lumps of ice.
Shake up thoroughly, strain into a sodawater glass and fill up the glass with soda or seltzer water. Ornament with berries.

Orgeat Lemonade.

(Use large barglass.)

Take 1 tablespoonful of powdered white sugar.
½ wineglass of orgeat syrup.
The juice of half a lemon.
Fill the tumbler one third full of fine ice, balance water. Shake well, and ornament with berries in season. Serve.

Fine Lemonade for Parties.

(One gallon.)

Take the rind of 8 lemons.
Juice of 12 lemons.
2 pounds of loaf sugar.

1 gallon boiling water.

Rub the rinds of the eight lemons on the sugar until it has absorbed all the oil from them, and put it with the remainder of the sugar into a jug; add the lemon juice (but no pips), and pour over the whole the boiling water. When the sugar is dissolved strain the lemonade through a piece of muslin, and when cool it will be ready for use. The lemonade will be much improved by having the whites of four eggs beaten up with it. A larger or smaller quantity of this can be made by increasing or diminishing the ingredients used.

TOASTS AND SENTIMENTS.

I'll toast America's daughters—let all fill their glasses—
Whose beauty and virtue the whole world surpasses.
May blessings attend them, go wherever they will,
And foul fall the man that e'er offers them ill.

Lovely woman—man's best and dearest gift of life.

Love to one, friendship to a few, and good-will to all.

May every woman have a protector, but not a tyrant.

Here's to the man who never lets his tongue cut his own throat.

Here's to the man who never quarrels with his bread and butter.

Here's to the man who never looks a gift horse in the mouth.

HINTS FOR YOUNG BARTENDERS

1. An efficient bartender's first aim should be to please his customers, paying particular attention to meet the individual wishes of those whose tastes and desires he has already watched and ascertained; and, with those whose peculiarities he has had no opportunity of learning, he should politely inquire how they wish their beverage served, and use his best judgment in endeavoring to fill their desires to their entire satisfaction. In this way he will not fail to acquire popularity and success.

2. Ice must be washed clean before being used, and then never touched with the hand, but placed in the glass either with an ice-scoop or tongs.

3. Fancy drinks are usually ornamented with such fruits as are in season. When a beverage requires to be strained into a glass, the fruit is added after straining; but when this is not the case, the fruit is introduced into the glass at once. Fruit, of course, must not be handled, but picked with a silver spoon or fork.

4. In preparing any kind of a hot drink, the glass should always be first rinsed rapidly with hot water: if this is not done the drink can not be served sufficiently hot to suit a fastidious customer. Besides, the heating of the glass will prevent it from breaking when the boiling water is suddenly introduced.

5. In preparing cold drinks great discrimination should be observed in the use of ice. As a general rule, shaved ice should be used when spirits form the principal ingredient of the drink, and no water is employed. When eggs, milk, wine, vermouth Seltzer or other mineral waters are used in preparing a drink, it is better to use small lumps of ice, and these should always be removed from the glass before serving to the customer.

5. Sugar does not readily dissolve in spirits; therefore, when making any kind of hot drink, put sufficient boiling water in the glass to dissolve the sugar, before you add the spirits.

7. When making cold mixed drinks it is usually better to dissolve the sugar with a little cold water, before adding the spirits. This is not, however, necessary when a quantity of shaved ice is used. In making cocktails the use of syrup has almost entirely superseded white sugar.

8. When drinks are made with eggs or milk, or both, and hot wine or spirits is to be mixed with them, *the latter must always be poured on the former gradually*, and the mixture stirred briskly during the process; otherwise the eggs and milk will curdle. This is more particularly the case when large quantities of such mixtures are to be prepared. Such drinks as "English Rum Flip," "Hot Eggnog" and, "Mulled Wine" are sure to be spoiled unless these precautions are observed.

THE LATEST

Hobson Rickey.

A regular rickey, sweetened with a lump of sugar, made in an old-fashioned toddy glass.

Greenie.

Take a split glass, half filled with shaved ice, add half a jigger of creme de menthe and half a jigger of Plymouth gin; syphon with seltzer.

Suissesse.

One-half jigger of absinthe, a tablespoonful of orgeat syrup, one white of egg; put into a mixing glass, fill with cracked ice, shake; strain into a wine-glass.

Dewey Cocktail.

Fill a small glass with equal quantities of creme yvette (blue), apricotine (red), and maraschino (white).

Gin Puff.

(DEDICATED TO PHIL ROELL.)

Take lemonade glass, fill ⅓ with fine ice, 1 spoonful powdered sugar, 1 jigger of old tom or phosphate gin, fill glass with milk, shake well and strain, 1 piece of lemon peel squeezed over top. Serve.

SHALL IT BE WHISKEY OR BEER?

BEVERAGES COMPARED.

How to Tell Whether You Are Physically Better Suited to One Than the Other.

Is it better for a man to drink whiskey or to stick to beer? Now, that is a very proper question for thousands of people, and it is very important that it should be answered correctly. If a man who ought to drink beer should confine himself to whiskey, the consequences might be disastrous; and the same would be true when a man whom nature has marked for a whiskey drinker devotes most of his bibulous energy to beer.

There is all the difference in the world between the two beverages, says a writer in the New York World. They are made, in the first place, of different materials. Beer being a sparkling beverage, is heavily charged in the process of fermentation with carbonic acid gas, while whiskey is quiet, and, in this respect, inoffensive. Beer contains very little alcohol in proportion to the whole quantity of fluid, sometimes but four percent, while whiskey contains from forty to fifty percent. Beer is therefore largely made up of water. Whiskey has very little water in its composition. Beer has a "bead," while whiskey has none. Beer is liable to spoil unless kept cold. Whiskey will keep at any temperature.

Adulterated beer is, without question, much more unhealthful than pure beer made of hops and malt, but when the healthfulness of any sort of beer is compared

with whiskey, it is not so much the ingredients of the beer that enter into the question as the general character of the liquid, and the effect of great quantities of it on certain organs, especially the liver, the kidneys, and the bladder.

A man who habitually drinks beer takes a much greater quantity of liquid into his system than one who drinks whiskey. It would therefore stand to reason that if they were equally harmful, admitting that they are harmful, the beer-drinker would suffer the more. It is also important to bear in mind that there is a great difference in temperament between different individuals. A man who can drink beer in considerable quantities with little bad effect, might be easily upset by a moderate indulgence in whiskey, and so, on the other hand, there are many persons accustomed to whiskey who are injuriously affected immediately on drinking beer.

Since it would be difficult to obtain proper subjects for an experiment of this sort, it will probably answer the purpose to compare beer-drinking countries, districts, and nations, with those that drink little beer, but consume great quantities of whiskey. An opportunity for such a comparison is afforded in studying the health statistics of the north and south of England.

The percentage of deaths in the south of England is somewhat larger, but the most curious difference between the two sections is, that while the north is comparatively free from gout and rheumatism, those diseases are very prevalent in the south. Gout and rheumatism are found to prevail especially in manufacturing cities, where much beer, porter, and ale are drunk. The same is true of the cities of Germany, whereas in Scotland and in Spain there is a happy absence of both maladies.

So striking has been the coincidence of the association of gouty disease with the habit of beer drinking that doctors have concluded there must be some pathological connection between them. It has also been found in individual cases that many patients who complain of gout have been beer-drinkers, and that they experience relief immediately on giving up this beverage.

Dr. S. Weir Mitchell declares that the safest drink is whiskey, provided there is not some objection peculiar to the individual. Probably most physicians will agree with the doctor's views generally, though they will all declare that whiskey, being strong in alcohol, should be used moderately.

The trouble with beer is that it puts a great tax on the liver and kidneys. The mere passing off of great quantities of liquid is unnatural, and when persisted in, so weakens these organs as to invite cirrhosis of the liver, Bright's disease, and other complaints.

Nevertheless, each man is a law unto himself, and after first determining to be moderate, you should find out which beverage you are suited for. One good test is to examine the tongue in the morning after drinking. If it is coated after drinking beer, and not coated after drinking whiskey, leave beer alone. If it is coated after drinking whiskey, but not after drinking beer, leave whiskey alone. If it is coated after drinking both, leave both alone.

Fizz Cocktail.

(A la T. G. Williams.)

Use medium thin glass: 1 lump of ice, a little sugar, 2 dashes of bitters, 1 jigger of Old Tom gin and fill up with seltzer, stir and serve.

Mulled Port.

(For 12 persons.)

Use large punch bowl. 5 quart bottles of port wine, 1½ lbs. sugar, 12 cloves, and 1 nutmeg grated; place in a saucepan over a fire till almost boiling, strain, and serve with ladle; also add one stick of cinnamon.

Balaklava Nectar.

(For 15 persons.)

Use large punch bowl. Peel 2 lemons and put peel in bowl; squeeze the lemon on them and add 4 tablespoons of sugar, press to extract flavor, add 2 bottles of plain soda water, 2 bottles of champagne, 2 bottles of claret, stir, put in a block of ice, dress with fruit, and serve with ladle.

OLDEN TIME DRINKS

One of the favorite drinks in olden times was that called "Lamb's Wool," which derived its name from the 1st of November, a day dedicated to the angel presiding over fruits and seeds, and termed "La masubal," which has subsequently been corrupted into "lamb's wool."

Recipe for Lamb's Wool.

To one quart of strong hot ale add the pulp of six roasted apples, together with a small quantity of grated nutmeg and ginger, with a sufficient quantity of raw sugar to sweeten it; stir the mixture assiduously, and let it be served hot.

Of equal antiquity, and of nearly the same composition, is the Wassail Bowl, which in many parts of England is still partaken of on Christmas Eve, and is alluded to by Shakspeare in his "Midsummer Night's Dream." In Jesus College, Oxford, we are told, it is drunk on the Festival of St. David, out of a silver-gilt bowl holding ten gallons, which was presented to that College by Sir Watkin William Wynne, in 1732.

Recipe for the Wassail Bowl.

Put into a quart of warm beer one pound of raw sugar, on which grate a nutmeg and some ginger; then add four glasses of sherry and two quarts more of beer, with three slices of lemon; add more sugar, if required, and serve it with three slices of toasted bread floating in it.

Another genus of beverages, if so it may be termed, of considerable antiquity, comprise those compositions having milk for their basis, or, as Dr. Johnson describes them, "milk curdled with wine and other acids," known under the name of Possets—such as milk-possets, pepper-posset, cider-posset, or egg-posset. Most of these, now-a-days, are restricted to the bed-chamber, where they are taken in cases of catarrh, to act as agreeable sudorifics. They appear to us to be too much associated with tallow applied to the nose, to induce us to give recipes for their composition, although in olden times they seem to have been drunk on festive occasions, as Shakspeare says—

"We will have a posset at the end of a sea-coal fire;"

and Sir John Suckling, who lived in the early part of the 17th century, has in one of his poems the line—

"In came the bridesmaids with the posset."

The Grace-cup and Loving-cup appear to be synonymous terms for a beverage, the drinking of which has been from time immemorial a great feature at the corporation dinners in London and other large towns, as also at the feasts of the various trade companies and the Inns of Court—the mixture of which is a compound of wine and spices, formerly called "Sack," and is handed round the table, before the removal of the cloth, in large silver cups, from which no one is allowed to drink before the guest on either side of him has stood up; the person who drinks then rises and bows to his neighbors. This custom is said to have originated in the precaution to keep the right or dagger hand employed, as it was a frequent practice with the Danes to stab their companions in the back at the time they were drinking. The most notable instance of this was the treachery employed by Elfrida, who stabbed King Edward the Martyr at Corfe Castle whilst thus engaged.

Beer Cups.

These cups should always be made with good sound ale, but not too strong; and should invariably be drank from the tankard, and not poured into glasses, as they are generally more agreeable to the taste than to the sight, and it is imperative that they should be kept hot.

Hot Ale Cup.

To a quart of ale, heated, add two wine-glasses of gin, one wine-glass of sherry, two tablespoonfuls of American bitters, plenty of cloves and cinnamon, and four tablespoonfuls of moist sugar.

Copus Cup.

Heat two quarts of ale; add four wine-glasses of brandy, three wine-glasses of noyeau, a pound and a half of lump sugar, and the juice of one lemon. Toast a slice of bread, stick a slice of lemon on it with

a dozen cloves, over which grate some nutmeg, and serve hot.

"Burnet" Cup.

A pint of Scotch ale, a pint of mild beer, half a pint of brandy, a pint of sherry, half a pound of loaf sugar, and plenty of grated nutmeg. This cup may be drank either hot or cold.

Burgundy Cup.

To a bottle of Burgundy wine add a wine-glass of noyeau, three wine-glasses of pine-apple syrup, one wine-glass of brandy, and a quarter of a pound of powdered sugar. Ice well: add a bottle of seltzer or soda-water before drinking, and serve with a sprig of borage.

Mulled Claret.

The best way of mulling claret is simply to heat it with a sufficient quantity of sugar and a stick of cinnamon. To this a small quantity of brandy may be added, if preferred.

Champagne Cup.

To a bottle of champagne add a wine-glass of Madeira or sherry, a liquor-glass of Maraschino, two slices of Seville orange-peel, and one slice of lemon-peel. Before drinking, pour in a bottle of seltzer-water, and serve with a sprig of verbena or a very small piece of thinly-cut peeling of cucumber

Moselle Cup.

To a bottle of Moselle add a sweet orange sliced, a leaf or two of mint, sage, borage, and the black currant. Let this stand for three hours; strain off, and sweeten to taste with clarified sugar.

Hock Cup.

To a bottle of hock add three wine-glasses of sherry, one lemon sliced, and some balm or borage. Let it stand two hours; sweeten to taste, and add a bottle of seltzer-water.

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suddenly deprived of its blood it will at once expire, since the blood nourishes the tissues, and confers its special properties upon them; but that, under certain circumstances, the vital manifestations may persist for a long time after the blood has been abstracted. This, he states, may be observed at any time in a cold-blooded animal, and especially during the cool season. Thus, a frog in winter will preserve its vitality for twenty-four hours after the withdrawal of its blood; and if one of the abdominal veins be opened and feebly saline or sugared water, or even mercury, be injected, until all the blood is replaced by the liquid, the animal may still move, leap, and manifest all the ordinary signs of life for several days. If the web of the foot be examined by the microscope, a fluid entirely destitute of globules will be seen to circulate in it, showing that the blood globules have been removed without suspending the functions of life. This is stated to be somewhat analogous to the condition of things in the hibernation of animals, and in the cold stage of cholera in man, during which the circulation may apparently cease completely, so that no blood shall flow if an artery be opened, and yet all the ordinary manifestations of life continue. In both cases a considerable reduction of temperature is observed, and the functions of the red corpuscles are reduced correspondingly in activity.

PHYSIOLOGICAL EFFECTS OF ALCOHOL.

An important memoir upon the effects of alcohol upon the human body was lately read before the Royal Society of London, giving the result of experiments prosecuted by two eminent army surgeons upon an intelligent British soldier. This man was perfectly healthy, and entirely unaccustomed to the use of spirits or tobacco in any form; so that the effects produced were direct, and could be readily appreciated. It was ascertained that small quantities of absolute alcohol—say one or two fluid ounces—given in divided doses, seemed to increase his appetite, while four fluid ounces lessened it considerably, and larger quantities almost destroyed it. While this particular effect may have been the result of peculiarities of constitution in the individual experimented upon, it is also possible that, in case of disease, much smaller quantities of alcohol might affect the appetite. The number of beats of the heart in 24 hours was increased very largely—to an average of at least 13 per cent.—and the actual work done by the heart, in excess of the normal task, was found to be equal to that of lifting 15 tons one foot; and, indeed, during the last two days of the experiment the extra work amounted to 24 tons.

The general conclusions, from this experiment and others which we have not time to mention, are very decided that, in case of ordinary health, the use of alcohol, even in small doses, is very much to be reprehended; but that, when the system is run down and enfeebled, it may be given as a stimulant, and for the purpose of causing the organs of the body to act with greater vigor.

EFFERVESCENT CITRATE OF MAGNESIA.

The London *Chemical News* copies, with much approval, from the *American Journal of Pharmacy* the following recipe for an improved effervescing citrate of magnesia, and extols it as much superior to the preparations under that name made and used in England. It is made by taking 4 lbs. of powdered citric acid, 1½ lbs. of calcined magnesia, 3 lbs. of bicarbonate of soda, 3 lbs. of tartaric acid, 6 lbs. of powdered white loaf-sugar, essential oil of lemons one-half a fluid ounce, and alcohol (very strong) as required. To the powdered citric acid the sugar is to be added, and the two thoroughly mixed; then the soda, magnesia, and tartaric acid are to be introduced, and the whole passed through a No. 4 sieve three times, to insure a thorough mixture. The powder is then to be moistened with the strong alcohol and passed through a No. 8 sieve, and placed on a wooden tray to dry, at a temperature of 120°. The oil of lemons is to be added when dry, and the whole is to be bottled in well-dried and clean bottles. This preparation can be kept an indefinite length of time.

ELECTRO-PLATING OF NICKEL.

We have already referred to an important improvement in the electro-plating of metallic objects with nickel as patented by Mr. Adams, of Boston, and now worked in several of our cities with much success, the result being to give to a great variety of articles—such as knives, forks, surgical and dental instruments, stair-rods, and-irons, students' lamps, plumbers' materials, etc.—a coating resembling polished steel, and quite as hard, and which is proof against ordinary oxidizing or other influences, retaining a high polish for a long period of time.

The special feature of Mr. Adams's invention, and that upon which the patent mainly rests, consists in the exclusion of the smallest quantity of potash, soda, or other alkaline earth from the bath containing the nickelizing preparation, pure double chloride of nickel and ammonium, or the perfectly pure sulphate of nickel and ammonia, and perfectly pure nickel being also required, as one of the electrodes, the nickel adhering regularly and strongly in consequence, and only needing polishing after the metal coated over is taken from the bath.

It seems, however, that this precaution, as indicated by Mr. Adams, is not necessary, and that the general process may be prosecuted by any one without infringement of the patent, as, according to M. Becquerel, potassa in no way affects injuriously the deposition of nickel, since the double sulphate of nickel and potassa can be applied as well as the double sulphate of nickel and

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WINE

The word "wine," in its wildest sense, includes all alcoholic beverages derived from sacchariferous vegetable juices by spontaneous fermentation. In the narrower sense of its ordinary acceptance, it designates the fermented product of grape juice, with which alone the present article proposes to deal. Wine making is an easy art where there is a sufficient supply of perfectly ripe grapes. In Italy, Spain, Greece, and other countries of Southern Europe, nature takes care of this. In the more northern districts of France, and especially on the Rhine in Germany, the culture of the vine means hard work from one end of the year to the other, which only exceptionally finds its full reward. And yet it is in those naturally less favored districts that the most generous wines are produced. Southern wines excel in body and strength, but even the best of them lack the beautiful aroma or bouquet characteristic of high-class Rhine wine. The large proportion of sugar in southern grape juice would appear to be inimical to the development of that superior flavor. To secure the highest attainable degree of maturity in the grape, the vintage on the Rhine is postponed nutil the grapes almost begin to wither, and the white grapes on the sunny side of the bunches exhibit a yellowish brown (instead of a green) color, and show signs of flacidity. In Spain, France, and Portugal it is a very common practice to dust over the grapes with plaster of paris, or to add the plaster to the must. The intention is to prevent putrefaction of the berries in the latter, to add to the chemical stability of the wine.

Effervescing or Sparkling Wines.

These wines are largely impregnated with carbonic acid, engendered by an after-fermentation in the closed bottle by means of added sugar.

The art originated in Champagne, where the best sparkling wines are produced, and whence it has spread to the Rhine, the Moselle, and other districts. A champagne which contains relatively little sugar is called "dry"; it is chiefly this kind which is imported into Great Britain, where champagne is used habitually principally as a dinner wine; inFrance a sweet wine is preferred. At the presentday wine is practically a European product, although a certain quantity is made in the United States, at the Cape of Good Hope, and in Australia.

France shows to-day, and has during several isolated seasons the past twenty years, shown herself to be the most remarkable wine-producing country country in the world's history, and this in face of the fact that the United States and Italy, with more territory suitable to grape-growing, and with wonderful natural advantages—and why? because she has taken advantage of her fitness of soil to the vine; her meteorological conditions; her geographical positions as regards the European markets, and incidentally those of the world, and partly to the aptitude of its inhabitants, that France developed the position which it now holds.

Spain is second only in reputation to France among wine-growing countries; its white wine, known as sherry, first brought it into prominence. Sherry, so called from the town of Jerez (Xeras) de la Frontera, the headquarters of this industry. There are several different varieties of sherry, which may be divided into the Amontillado and Manzanilla classes. The Amontillado class may again be divided into *fino* and *oloroso*, the former being the more delicate. The generous, full flavored wines known as Port, are the produce of the district of Alto Douro, in the northeast of Portugal, and thence shipped to and from Oporto.

Home Industry.

In our own country the cultivation of the vine has made rapid progress of late years, and American wines are steedily taking the place of the foreign product. The soil and climate of the Pacific Coast seem best adapted to the growth of the vine, and wine-making is very likely to become one of the leading industries of California. The Mission grape (being the first) is supposed to have been imported from Mexico by the Franciscan fathers about the year 1769. Subsequently varieties of French, German, and Spanish wines were introduced into the state. In Ohio upon the shores of Lake Erie and along the Ohio river the vine is extensively cultivated. The champagnes and clarets made in the neighborhood of Sandusky and Cleveland are produced in considerable quantities.

New York, Missouri, Illinois, and Pennsylvania

are likewise large producing states, the largest wine manufacturing establishment being in New York State, Steuben County. The total annual production of wine in the United States now amounts to about 35,000,000 gallons.

The Qualities of Good Wine

In the 12th century are thus singularly set forth: "It should be clear like the tears of a penitent, so that a man may see distinctly to the bottom of the glass; its color should represent the greenness of a buffalo's horn; when drunk, it should descend impetuously like thunder; sweet-tasted as an almond; creeping like a squirrel; leaping like a roebuck; strong like the building of a Cistercian monastery; glittering like a spark of fire; subtle like the logic of the schools of Paris; delicate as fine silk; and colder than crystal." If we pursue our theme through the 13th, 14th, and 15th centuries we find but little to edify us; those times being distinguished more by their excess and riot than by superiority of beverages or the customs attached to them. It would be neither profitable nor interesting to descant on scenes of brawling drunkenness which ended not unfrequently in fierce battles; or pause to admire the congregation of female gossips at the taverns, where the overhanging sign was either the branch of a tree, from which we derive the saying that "good wine needs no bush," or the equally common appendage of a besom hanging from the window, which has supplied us with the idea of "hanging out the broom." The chief wine drunk at this period was Malmsey, first imported into England in the 13th century, when its average price was about 50s. a butt; this wine, however, attained its greatest popularity in the 15th century. There is a story in connection with this wine which makes it familiar to every schoolboy, and that is the part it played in the death of the Duke of Clarence. Whether that nobleman did choose a butt of Malmsey, and thus carry out the idea of drowning his cares in wine, as well as his body, matters but little, we think, to our readers. We may, however, mention that although great suspicion has been thrown on the truth of the story, the only two contemporary writers who mention his death, Fabyan and Comines, appear to have had no doubt that the Duke of Clarence was actually drowned in a butt of Malmsey. In the records kept of the expenses of Mary, Queen of Scots, during her captivity at Tutbury, we find a weekly allowance of Malmsey granted to her for a bath. In a somewhat scarce French book, written in the 15th century, entitled 'La Legende de Maitre Pierre Faiferi,' we find the following verse relating to the death of the Duke of Clarence:—

> "I have seen the Duke of Clarence
> (So his wayward fate had will'd),
> By his special order, drown'd
> In a cask with Malmsey fill'd.
> That that death should strike his fancy,
> This the reason, I suppose:
> He might think that hearty drinking
> Would appease his dying throes."

wine called "Clary" was also drunk at this period. It appears to have been an infusion of the herb of that name in spirit, and is spoken of by physicians of the time as an excellent cordial for the stomach, and highly efficacious in the cure of hysterical affections.

Sir Launcelot Sparcock, in the "London Prodigal," says—

> "Drawer, let me have *sack* for us old men;
> For these girls and knaves small wines are best."

In all probability, the sack of Shakespeare was very much allied to, if not precisely the same as our sherry; for Falstaff says, "You rogue! there is lime in this sack too. There is nothing but roguery to be found in villainous man; yet a coward is worse than sack with lime in it." And we know that lime is used in the manufacture of sherry, in order to free it from a portion of malic and tartaric acids, and to assist in producing its dry quality. Sack is spoken of as late as 1717, in a parish register, which allows the minister a pint of it on the Lord's day, in the winter season; and swift, writing in 1727, has the lines—

> "As clever Tom Clinch, while the rabble was bawling,
> Rode stately through Holborn to die of his calling,
> He stopped at the 'George' for a bottle of sack,
> And promised to pay for it when he came back."

He was probably of the same opinion as the Elizabethan poet, who sang—

> "Sacke will make the merry minde be sad,
> So will it make the melancholic glad.
> If mirthe and sadnesse doth in sacke remain,
> When I am sad I'll take some sacke again."

The Art of Drinking Wine.

To know how to drink wine belongs only to a cultivated taste; to know how to tempt guests to indulge in it with pleasure belongs only to the host gifted with rare tact and artistic discrimination.

A painting from the hand of a master must be placed in a favorable light and with appropriate surroundings to set off its excellence; the most beautiful woman despises not the art of enhancing her charms by harmonious auxiliaries or by judicious contrasts.

There is, in the same manner, an art and a science in drinking celebrated wines.

After studying the menu one can decide on a choice

of wines, and on the order in which they are to be served.

The following rules should be observed.

With Fish: White Wines. With Meats: Rich Red Wines.
At the Conclusion of the repast: The Oldest Red Wines.
After the desert: White, Sweet and Sparkling Wines.

In regard to the gradation of red wines the rule is to commence with the newest and least celebrated.

We shall see how these rules are followed by a generous liver:

A few spoonfuls of soup, by their agreeable warmth, prepare the palate and stomach to fulfill their wholesome functions; a drop of golden Madeira or of old Sherry gives these organs all the necessary activity.

With the oysters, which are followed by the fish, come the fine Moselle and Rhine Wines, and the white Bordeaux or white Burgundy wines, half dry or sweet, far preferable to Champagne Frappe. When the fish and oysters are removed, so are the wines.

When meat is on the table, the proper accompaniment is the red Bordeaux wine, mellow and rich, clad in resplendent purple and with a perfumed bouquet.

With Canvas Back, Mallard and Teal Duck, richer meats—roat beef, wild boar, roebuck—is served excellent, heady, rich red Burgundy.

When midway in the feast, the guests have arrived at that satisfactory stage when the stomach, still docile, manifests no further desires; when the taste, prepared by a judicious gradation of sensations, is susceptible of the most delicate impressions, the noble red Bordeaux wines make their triumphal entry, and the "maitre d'hotel" proudly announces their illustrious names: Chateau Margaux! Chateau Lafite! Chateau Latour! Chat. Haut Brion! Chat. Larose!

After these wines, one can enjoy sweet Sauternes and quaff a few glasses of foaming Champagne.

HOW WINES SHOULD BE SERVED.

Wines should be always served in dry glasses.

Ordinary wines for daily use, fine ones for gala occasions. The use of fine wines at the table and in families is a science and a fine art. White wines go with fish; with meats, the rich red wines; between the meal proper and dessert, the oldest red wines procurable. After dessert, rich white and sparkling wines.

White Wines.—Place the bottle upright in the coolest spot available, but not in contact with ice, nor let it suffer from the cold.

Rhine and Moselle.—All Rhine and Moselle wines should be drank slightly cold.

Claret and Burgundy.—Place bottles upright in the warm dining-room a day before using. Decant the wine carefully just before serving. Ice—never.

Champagnes should be thoroughly cold when served. The Brut, however, should not be quite as cold as the Dry. A very low temperature destroys their fine bouquet and delicacy. Never mix champagne with ice or water.

Ports.—Store bottles on end on a shelf in a moderately cool room or cellar. The wine being warm and generous, should not be drank cool. Port wine is not a mere luxury; it has high medicinal properties.

Sherries and Madeiras.—Bottled Sherries and Madeiras may be stored upright the same as Port, but are best when cool.

All wines should be stored in a cool place, lying down.

When wine is received it should be placed in a cellar or room where a normal temperature of from 55 degrees to 65 degrees Fahrenheit is maintained, and bottles should be laid so that contents cover the cork, thus completely preventing the admission of air into the bottle. Hence the advisability of uncorking only such quantities as can be consumed.

Sweet wines, unlike dry wines, can be consumed at leisure, and they retain their excellent qualities for an indefinite period after the cork is drawn. In using wines for medicinal purposes it should be borne in mind that the proper time is while eating, and not before or after meals. All wines, when pure, more especially the red class, after remaining in bottles over six months, show a sediment; this is a natural deposit, and greatly improves the quality.

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ammonia; but if the positive electrode is not made of nickel, it is necessary to add free ammonia in order to saturate the sulphuric acid which is set free.

VALUE OF VARIOUS ANTISEPTICS.

Dr. Crace Calvert, in a recent paper, gives the result of investigations into the antiseptic power of various substances. One series of experiments consisted in placing in uncorked bottles solutions of albumen and of flour-paste, and then adding various portions (from two to five per cent.) of the different antiseptics in question. The result of the experiments proved that the only real antiseptics known at the present time are carbolic and cresylic acids, all other mixtures acquiring an unpleasant odor in from five to sixteen days.

The second series of observations consisted in placing a known quantity of the antiseptic in the bottom of a wide-mouthed pint bottle, and suspending over it by a thread a piece of sound meat. In this case, again, the meat became putrid in from four to twenty-five days, excepting in the case of the acids just mentioned, over which the flesh remained untainted, but dried up quite hard. Chloralum, which has been much praised lately as an antiseptic, was found to be below the average as a preservative.

CHANGING THE COLORS OF THE FLOWERS OF THE HYDRANGEA.

Some of our readers may not be familiar with the readiness with which the color of the flowers of the common garden hydrangea can be altered artificially. If a sixth part of iron filings be mixed with the earth in which the plant is grown, it will frequently, although not always, change from its original pink color to a light blue. A cutting, however, taken from the plant thus changed, and grown without iron filings, reverts to its previous color.

FREEZING MIXTURES.

It is well known that there are certain so-called freezing mixtures which, by their solution in water, tend to produce a greater or less degree of cold—the most familiar illustration of the fact being seen in the application of salt to ice in freezing ice-cream or cooling Champagne—the ice melting, but the saline liquid indicating a temperature much below that of frozen water. There are other substances, however, the use of which produces a much greater degree of cold than that obtained by means of salt, the most conspicuous among these being finely pulverized crystallized nitrate of ammonia. If this be dissolved in an equal weight of cold water, at 50° Fahr., a reduction of temperature to 3.20° Fahr. will result.

Again, if a mixture of seven parts of sal ammoniac, seven of saltpetre, and eleven of Glauber's-salt be dissolved in twenty-two parts of water at 50° Fahr., the column of a mercurial thermometer immersed in the mixture will fall to 4.10° Fahr., or nearly the same as the preceding reduction. This, therefore, may be considered as much superior to any other combination yet proposed for practical use in the production of a low degree of temperature. The nitrate of ammonia has, however, the advantage, even if more expensive, that it may be used over and over again, it being only necessary to evaporate the solution to the point of crystallization, while the mixture just referred to can only be used once.

In one instance, with the air at 60° Fahr. and the water at about 54°, a thick, cylindrical cup of very hard ice, about eight inches high and several lines thick, was produced in about fifteen minutes.

An interesting experiment bearing upon the same point may be made by melting together 59 parts of tin, 103½ of lead, and 183 of bismuth. If this be finely rasped or powdered, and introduced into 108 parts, by weight, of quicksilver, we shall find that the thermometer immersed in the mixture will sink to 3.20° Fahr.; and water placed in a thin test-tube, and allowed to remain for a few minutes in this bath, will be completely frozen.

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THE WINE CELLAR

PORTS AND SHERRIES—Store bottles on end on a shelf in a moderately cool room or cellar. The wine being warm and generous, should not be drank cold.

Port wine is not a mere luxury: it has high medicinal properties. It is a tonic, and it has greater or less astringency according to the various growths and vintages. The wine derives its name from the city of Oporto, located where the river Douro enters the sea, and the wild, mountainous country through which this boisterous river dashes is the place of growth of this wine; the vineyards extending in terrace upon terrace from the edge of the river to the top of the highest mountain in the "Alto Douro" district of Portugal.

There is a prevailing notion that genuine ports are not obtainable. If invalids and convalescents knew of the splendid tonic and building-up properties of our real ports, they would not be slow in obtaining them. We advocate only wines of the highest merit. Fine Old Port, Sherry, Burgundies, Clarets, Madeira, pure California Wines, Sauternes, and Champagnes.

There are wines grown in Spain resembling port, such as the "Tarragonas"; and in France is made a wine resembling port, known as the "Roussilion," but a much better substitute than either of these is the pure port wines of Southern California grown from the same varieties of grapes as are native to the Alto Douro district.

The word "sherry" is a corruption of Jerez (or Xerxes)—Jerez de la Frontera, situated in the midst of vineyards covering a tract of country twelve and one half miles long by ten miles broad, in Andalusia, the proper home of this wine. The term "bodega" originates here. It means a lofty, capacious storehouse, a substitute for a cellar, divided into from three to six aisles by rows of pillars, well lighted and ventilated; the rays of the fierce southern sun being carefully excluded by shutters or blinds of esparto. Many of these bodegas are so long that 100 butts of wine lie side by side in the row, and as these rows are composed of tiers three and four butts high, some idea may be formed of the number of butts housed beneath a single roof. Sherries are remarkable in that the better grades develop with age a great variety of flavors; indeed, it has been asserted that no two butts of wine from the same vineyard or vintage will be alike, each one possessing different characteristics, although pressed from the same grape. From ten to twenty percent of the vintage will become irremediably bad. Of the rest some wines remain *Vinos finos*, pale, dry, soft, delicate and fresh tasting; others passing through the *finos* stage attain the dignity of *Amontillados*, stouter, dryer, more pungent and possessing a marked etherous flavor. Others develop into *Oloroso*, the classic wine of Jerez, darker, fuller, richer and mellower, with a nutty flavor and an exquisite bouquet. When they are four years old they are admitted to the dignity of forming a part of the "Sölera."

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This solera system is peculiar to Jerez. It means the building up new wines on the foundation of old ones.

As the older wines are drawn off for shipment—and but a few gallons are drawn from each butt in the lowest tier—these butts are replenished from the casks immediately above them, these in turn from the next tier, and finally new wine of the same character is replenished to the top row. By this system it is possible for the shipper to keep up a uniform excellence of his wines, and to duplicate each shipment despite a succession of bad vintages. There are other districts surrounding Jerez where good wines are grown. The pale, delicate Manzanilla is grown around the little town of San Lucas de Barrameda, about fifteen miles from Jerez, and Puerto de Santa Maria yields somewhat inferior wines to the neighboring districts mentioned.

THE MEDOC.—The vineyards of the Medoc, whence come the most famous wines of the world, present many wonderful facts. The grapes are curious in variety, as also in their size and appearance, consequently also in the quality of the wine produced.

An extraordinary fact it is that a narrow lane sometimes divides a vineyard so that on one side there will be a first-class production, while its opposite neighbor has hardly a name with the wine buyers. The same mode of cultivation will not remedy this caprice of nature. Sometimes a trifling slope of the ground, varying a little the exposure of the plant, will cause a perceptible difference in the flavor of the fruit. The vines themselves are never suffered to grow more than three feet in height, careful pains being taken by the vine dresser to maintain quality at the expense of quantity.

It is a peculiar feature of the wines of the Bordelaise that you will rarely, if ever, find a connoisseur who will confess an undivided and exclusive attachment to any one particular growth. The claret drinker flits from vineyard to vineyard without being able to fix his affection once and forever. Not so on the Rhine. There are found the partisans, each one of whom enthusiastically lauds his particular favorite.

Clarets are gently stimulating, perfectly wholesome, and possess the inestimable property of building up bone and muscle of the human frame. The higher grades are classified into five Crus. Thereafter come the wines of "Bourgeois" and "Artisan" growths. The last named are not suitable for exports, but are consumed by the peasants and laboring classes.

CHAMPAGNES.—Champagne, as everybody knows, takes its name from the French province in which it is produced, but everybody does not know that Sparkling Champagne was the discovery of a monk belonging to the royal monastery of St. Pierre at Hautvilliers. His name was Father Perignon, and he died in 1715. The chief depots of Champagne are at Ay, Epernay and Rheims, where the quantity kept in stock is exceedingly large. The sparkle, or "mousse," as the French term it, which characterizes Champagne, is produced by the development of carbonic acid gas from the saccharine constituents of the grape juice, and is sometimes assisted in bad years by the addition of sugar to the fermenting wine. Afterward, when the wine has fermented in the cask until the spring, it is bottled. In the bottle slight fermentation continues, and a sediment is formed, which is adroitly thrown out shortly before the wine is required for the market, and this process is termed "disgorging." The wine then receives a certain quantity of liqueur, composed of the finest cane sugar dissolved in old still wine. Champagne merchants have each their own views as to the quantity of liqueur which ought to be used, and this again is made to vary to suit the fancied requirements of different markets. "Extra Dry" Champagne contains less of the saccharine admixture than "Dry," and "Brut" should contain none whatever.

The best vintages have been 1874, 1880, 1884, 1887 and 1889. The London champagne buyers whenever there is a choice vintage, buy it and take it to London, so that the greater portion of good Champagnes are only to be found there.

Heretofore the wines shipped to America have been much sweeter than those used in London, but now Extra Dry or Brut Wines are becoming more popular here every day. Champagnes for the English market, and generally called "Brut," contain from one to two percent liqueur.

The best Rhenish wines are produced in what the Germans term the Rheingau, a region of hills on the right bank of the Rhine, about twenty-five miles in length, extending from Walluf to Loch. In the middle of this district is the Schloss Johannisberg, given by the Emperor of Austria to the late Prince Metternich. In the Rheingau are produced, among other wines, the celebrated Rudesheimer, Marcobrunner and Hochheimer, from the latter of which the English word "Hoch" is supposed to be derived. On the left bank of the Rhein is Rheinhessen, where Niersteiner and other well-known wines are grown. All Rhein wines have marked chemical characteristics; they contain but little sugar, and the proportion of alcohol rarely exceeds twelve parts in a hundred, hence their great value medicinally, especially to those who are troubled with gout. The sparkling wines of the Rhein are comparatively of recent date. Their process of manufacture resembles that of Champagne.

BURGUNDIES.

The wines of the Province of Burgundy are both red and white, and are grown in the departments of the Cote d' Or, the Yonne and the Soane-et-Loire.

The Burgundy district commences about a hundred

miles southeast of Paris, on the road to Dijon. Hills of chalk form the soil on which the vineyards are planted, and the vines are trained on sticks about three feet long.

Burgundy wines are famous for their delicacy, piquancy, fragrance, richness of flavor and medicinal tonic properties. The white wines—of which Montrachet stands first in rank, and Chablis is the best known—are famous for luncheon and dinner purposes, Chablis being especially agreeable with oysters.

The different kinds of wine may well be spoken of as follows:

MACON.—A sound, pure wine, with excellent body and flavor; a splendid dinner wine.

POMMARD.—A choice wine of the Cote-d'Or. It is full, rich and delicate in flavor.

BEAUNE.—An acceptable and strong good wine for invalids who may be ordered to drink good Burgundy in preference to any other.

NUITS.—An exceedingly nutritious wine, with great flavor, and a decided bouquet, smooth and agreeable.

ROMANEE.—The most delicious and exquisite of red Burgundies.

CLOS DE VOUGEOT.—Paramount among red Burgundies as being the perfect, unsurpassable wine of its class. The vineyard producing it is held in high esteem by all Frenchmen.

CHAMBERTIN.—A famous red Burgundy of the very highest class, wonderfully soft and delicate, with brilliant ruby color. The wine is prized as most choice by those who, in matters of wine, are cognoscenti.

The Portuguese word "Madeira" means "wood," and the name was given to the island when first discovered, on account of its being covered with a dense forest. The culture of the grape commenced in Madeira early in the fifteenth century. The vines are trailed on frameworks of cane, and grow in ashy soil, the island being volcanic. Madeira wine is very rich, full-bodied and aromatic. A voyage to the East or West Indies improves its condition in a wondrous degree.

Moselle Wines.

I wish to direct attention to these wines. I think that they are not appreciated as highly as they should be here. They are light and less rich than the Rhine wines, and very wholesome. For drinking with oysters and all sorts of fish there are none finer.

The wines produced on the banks of the Moselle were famous before those of the Rhine had gained celebrity. Those which are most celebrated are grown on the lower Moselle, between Treves and Coblentz. Moselle is a very bright wine, and should have a greenish yellow color, with muscatel flavor, and peculiarly pleasant aroma. It is regarded as one of the most wholesome of wines, for, being cool and dry, it refreshes without unduly heating the system. Sparkling Moselle has of late years come very much into favor.

WINES OF CALIFORNIA.—The fact that California now produces over one half of the wine consumed in the United States is evidence of the rapid stride this young state is making in viticulture. The errors that have been made in the past by growers have naturally resulted in good, and ambitious viticulturists, profiting by such experience, are coming forward with wines which, while distinctly Californian, are destined to become known among connoisseurs and recognized as high types of a new class.

To those who are unacquainted with this progress of the past few years we will show wines of high quality, particularly of the dry wines from the northern part of the state, some of which suggest the finer red wines of Hungary and others the products of the choicer sections of France. It is as California wines that they should be judged however, for while having these resemblances they are a separate and distinct class.

With the ambition and enthusiasm of youth, a far-famed climate showing great variety in the different sections, and much foot-hill land of suitable soil, the Golden State may be expected some day in the not far distant future to take high rank in the production of wine.

How to Manage Wine and Beer.

All wine, particularly light-bodied and sparkling, require to be kept on their side and at a uniform temperature of 55 degrees. Claret, Burgundies, and also white wines should be decanted very carefully in removing them from the bin when about to be used, otherwise the deposit is liable to become mixed with the liquid, and the flavor destroyed. Old bottled wines will lose many of their properties *unless carefully* decanted.

Wine old in bottles should be drunk immediately on being decanted. If allowed to remain open for any length of time the delicate aroma, so much esteemed, will be lost, and the wine become vapid.

All aerated waters should have their corks kept damp, and be placed cork downwards.

Bottled stout and ale should be placed cork upwards; when required for use they should be moved carefully, and the whole poured out without putting down the bottle, otherwise the sediment will be shaken into the liquor.

Draught stout or beer when tapped, if wanted for quick use, should have a porous vent peg put in the bung, and left a short time to clear; if the draught is slow, give it time to fine without venting.

The beer cellar should be lofty, dry, and well ventilated.

Mean and adulterated drinks supply the temperance fanatics with their most powerful arguments, and if it were possible to abolish the manufacture and sale of these abominable concoctions there would be less need for restriction of the traffic. When such whiskeys as

are put upon the market, and which for years have proved all that is claimed for them—a bland ripe, and delicious whiskey, that has few equals, the favorite with *bon vivant* and medical practitioner alike—then it is a friend, supplying thousands with the means of maintaining health and strength and enjoyment.

The mistaken treatment of diluting claret with ice water develops all its rough flavor and crude properties.

The O-neh-da Vineyard, Rochester, N. Y., was organized and is conducted by Monseigneur McQuaid, bishop of that city. The property, it is said, belongs to the Rochester Seminary, of which he is the head. Several years ago the bishop spent several weeks in the white wine district near Bordeaux, studying the making of sauternes.

If the whiskey dealers allow the whiskey sold over the bars to deteriorate, while the other alcoholic beverages sold far cheaper improve in quality, they must expect to lose business very rapidly.

Wines of Hungary and Austria.—The wines of Hungary, with the exception of Tokay, rank with the most inexpensive wines of Europe, quality considered. They are medicinal in a marked degree, promoting digestion and being particularly rich in phosphoric acid.

The lighter red wines resemble somewhat the clarets of the Medoc, as do the richer wines bear resemblance to those of Burgundy, and the white wines might be compared with the product of the Rhinegau, but they possess marked independent characteristics and have the generous but fiery individuality of the Magyar race which produces them.

Wines of Italy.—Italy is the largest wine-producing country in the world, the annual product being over nine hundred millions of gallons. Vineyards extend throughout the length and breadth of the land, from the foot of the Alps in the north to the southernmost Sicily. Spain takes second place in the annual yield of wine, but France is not far behind Spain in quantity, whereas in point of value of its annual vintage France eclipses every other country.

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MORTAR FOR USE IN DAMP PLACES.

It is said that a mortar can be prepared, admirably adapted for plastering walls and roofs in moist localities, by mixing freshly slaked lime and saw-dust made from very soft wood (rather fibrous than granular), and using only enough lime to permit the mass to attach itself to the wall without difficulty. These two ingredients combined, it is said, form a complete felting, which appears as if impregnated with lime, and so tough that a blow affects only the spot where it falls, without loosening the general mass.

This mortar is said to be especially adapted for plastering coffer-dam work, the inside of wells, cob-walls, etc. Applied in a layer of a quarter of an inch thick to the boards of an ice-house, against which the ice was densely packed, it was not affected in the least by the moisture. Rooms plastered with this mortar can, it is said, be papered in a few weeks.

EUCALYPTUS TREE.

The *Eucalyptus globulus* is esteemed in Australia on account of its wood, which is very hard and superior to teak; and for its leaves, which contain a peculiar camphor-like essence, known as eucalyptine, which dissolves caoutchouc more readily than sulphide of carbon does. It is suggested that in the southern part of France, and in Spain, this plant would be very useful as a forest tree, since it reaches, in its native climate, an enormous height and size; and it may be well to consider the propriety of experimenting upon it in California and Arizona, where the temperature and amount of moisture in the soil, as well as the composition of the soil itself, may be much like that of its native country. Should the peculiar properties of its leaves as a febrifuge be established, and its asserted equality and possible superiority to quinine be substantiated, it should be considered an object of the utmost importance to introduce it.

THEORY OF BESSEMER AND HEATON STEEL PROCESSES.

In the course of certain remarks respecting the production of artificial charcoal iron Mr. Berthault observes that both Bessemer and Heaton base their systems upon the purification of the pigs by oxidizing reaction either of nitrate of soda or of nitrate of potash; but, referring to the quantities of alkaline salts contained in various fuels, Mr. Berthault remarks that the results appear to prove that soda or potash salts, thrown into the blast-furnace at the same time as the ore and fuel, would give with coke or other mineral fuel a metal closely resembling charcoal iron, and even a steely pig. Every thing will depend upon the quantity of soda or of potash added, and he contends that the best salt to employ is the neutral carbonate of potash, such as is obtained from vegetable sources, and commonly known as pearlash. To obtain iron of uniform quality in the blast-furnace it is desirable to mix the salt with some glutinous liquids, such as blood and water, and dampen the coke with it.

COLOROMETRIC DETERMINATION OF GOLD IN QUARTZ.

A process for the colorometric estimation of the quantity of gold in quartz has been submitted by Mr. Skey, of the government laboratory, to the Philosophical Society of Wellington, New Zealand, which is said to meet all requirements without the necessity of using quicksilver. The stone to be estimated, after having been thoroughly crushed and calcined, is immersed in a bath of iodine or bromine, and permitted to stand for some time. Slips of Swedish filtering-paper are then dipped in the fluid and dried alternately until the paper is thoroughly saturated, after which they are burned in a muffle. If no gold be present the ashes will be white, but one pennyweight to the ton will give them a beautiful purple color. It is believed that further experiments, with iodine or bromine baths, of known contents of gold, will enable the exact proportion of gold to be tested by the colorometric method.

PAPER FROM OAT REFUSE.

Paper is manufactured from oat refuse by Mr. Hay, of Glasgow, by first immersing the oat husks in water in a tank in order to float off mustard and other seeds, with which they are frequently more or less mixed, and which, if not separated, materially deteriorate the quality of the paper. It is of advantage to have the water well stirred, as it facilitates the separation of the foreign seeds, and allows them to float to the surface. The oat husks are then allowed to settle, and the surface scum and floating seeds are drawn off by an overflow pipe at the top of the tank, or skimmed off by a rake or other tool, or otherwise removed; after which the water is drained from the oat husks by a waste-water pipe at the bottom of the tank, and beneath a perforated false bottom, or fitted with a strainer which retains the oat husks. The oat husks may be left to steep in the water for from five to ten hours after or during the removal of the scum, as this steeping, by softening them and helping to loosen the silica from the fibre, facilitates the subsequent boiling process.

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HEALTH AND ALCOHOL

The British Medical Association, moved by the outcry against the use of alcoholic drinks, and wishing for some definite and reliable information as to the influence of alcohol on the duration of life, appointed a commission not long ago to gather statistics in the premises. The observations made included 4234 cases of deaths in five classes of individuals, and here are the results in the average age attained by each case: Total abstainers, 51 years and 1 month; moderate drinkers, 63 years and ½ month; occasional drinkers, 59 years and 2 months, habitual drinkers, 57 years and 2 months; drunkards, 53 years and ½ month. It appears that moderate drinkers live longer than anybody else, and total abstainers are the shortest lived.

WHISKEY

Whisky or whiskey, a spirit distilled for drinking, which originated, at least so far as regards the name, with the Celtic inhabitants of Ireland and Scotland, and its manufacture and use still continues to be closely associated with those two countries.

Distilled spirit first became popularly known as aqua vitæ, and it was originally used only as a powerful medicinal agent. It was not till about the middle of the 17th century that it came into use in Scotland as an intoxicating beverage. It is only the finer qualities of matured malt and grain whiskey that can be used as simple or unblended spirit. In the United States whiskey is distilled chiefly from corn and rye, wheat and barley malt being used, though only to a limited extent. Whiskey is greatly improved by age; it is not mellow, nor its flavor agreeable until it is several years old. Whiskey seems to be the most favored drink in America for purposes of stimulation, and in uncertain moments when one is undecided as to what to take it is generally regarded by steady drinkers as the purest and most reliable drink. They appear to know good whiskey by the taste of it.

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BREWING

Is the art of preparing an exhilarating or intoxicating beverage by means of a process of fermentation. In the modern acceptation of the word, brewing is the operation of preparing beer and ales from any farinaceous grain, chiefly from barley, which is at first malted and ground, and its fermentable substance extracted by warm water. This infusion is evaporated by boiling, hops having been added to preserve it. The liquor is then fermented. The art was known and practiced by the Egyptians many hundred years before the Christian era, and afterward by the Greeks, Romans, and ancient Gauls, from whom it has been handed down to us. All countries, whether civilized or savage, have, in every age, prepared an intoxicating drink of some kind. Great care must be taken when buying for malting, for sometimes the grain is doctored by kiln-bleaching, or dried at too great a heat. Several samples, too, may be mixed, in which case they will not grow regularly, as heavier barley generally requires to be longer in steep; and the grains, broken by the drum of the threshing-machine being set too close, spoil a sample. Those cut into sections will not germinate, but in warm weather putrefy, as is evident from their blue-gray and moldy appearance and offensive smell while germinating. A good buyer will, by the use of a skillful hand, estimate very closely the weight per bushel in bulk. His eye will tell him if the grain has been cut before being ripe, in which case there will be a variety in the color of the barley-corns, some being bright and some a dead, grayish yellow. In consequence of being sown in spring, and not undergoing the equalizing tendency of winter, barley is, of all grain, the most liable to ripen in a patchy manner, and not come to perfection simultaneously. The buyer has also to judge if it has been heated, or "mow-burnt," while lying in the field after being cut, or in the stack.

An Excellent Polish for Woodwork.

Two oz. alcohol, 2 oz. raw linseed oil, ¼ oz. gum shellac, ¼ oz. gum arabic, 4 drops ammonia; dissolve ten hours.

PUNCHES AND SHERBETS FOR THE DINNER TABLE

NOTE. Punch or Sherbet is served between the last entree and game or roast. The difference between Sherbet and Punch is that the former is a water Ice, into which some liquor is mixed, while Punch is an Ice, either of water or cream mingled with some Italian Meringue and liquors.

Banana Frappe.

Mash two bananas to a pulp; mix with juice of one lemon, one cup sugar, one cup water, one teaspoonful vanilla extract. Rub through strainer. Put all together in freezer and freeze till it begins to thicken, then add the white of one egg beaten to stiff froth. Freeze firm.

NOTE: Any kind of Frappé can be made by substituting other fruit for bananas.

Fruit Mousses,

With Pineapple or other Fruit.

Strawberries, raspberries, apricots, peaches, pineapples, etc., to be used.)

One quart of cream must be whipped till very light; drain it on a sieve and then transfer it to a bowl. Add one pound pineapple puree and one pound of sugar, mixing both together with a little vanilla and a gill of Kirsch. Whip the preparation in a tin basin on ice for ten minutes to have the cream and pulp assimilate well together. Coat the inside of a high dome mold with Virgin Strawberry Cream; fill the center quite full with the preparation, and close the mold. Pack in ice for one hour, unmold on a napkin, and surround with small iced cakes.

Any other fruit may be substituted for the pineapple.

Virgin Strawberry Ice Cream.

Add three pints sweet cream and a pint of milk to one quart of strawberries and two pounds of powdered sugar. Melt the sugar. Strain the whole through a silk sieve and freeze.

Imperial Punch.

Put three gills of pineapple juice in a vessel with the juice of two lemons and the peel of one orange; also one half ounce of tea infused into a pint of water, three gills rum, two gills brandy, one gill Kirsch, one gill Maraschino. Bring this to 16°. Then freeze. When frozen, add one half as much ice.

Regent Punch.

Take 1 quart water.	1 pound sugar.
1 pint gin.	1 pint maraschino.
2 lemons.	4 bottles club soda.

Grate the rind of lemon into a bowl, moisten with some gin and rub with the back of a spoon to extract flavor; add the lemon juice and the rest of ingredients, except soda. Strain into the freezer and freeze as firm as the spirit will allow. Add the bottled soda and finish freezing.

Victoria Punch.

Take 6 or 8 oranges.
12 lemons.
3 pounds of sugar.
8 whites of eggs.
2 pounds of water.
1 pint of sweet wine.
½ pint rum.

Grate the rinds of half the lemons into a bowl, add the rum, and rub with the back of a spoon to extract the flavor. Squeeze in the juice of all the fruit, add other ingredients and freeze. Then whip the whites, stir in; beat up; and freeze again.

Turkish Sherbet.

Take 1 quart sweet wine.
1 quart water.
2 pounds of sugar.
2 lemons—juice only.
6 oranges—juice only.
8 ounces blanched almonds.
8 ounces muscatel grapes.
4 ounces figs, cut small.
4 ounces seedless raisins.
8 whites of eggs.
6 cloves, a small piece of cinnamon and a little caramel coloring.

Make a hot syrup of the sugar and water and pour it over the raisins, cloves and cinnamon. When cool add orange, lemon juice and wine. Strain and freeze in the usual manner. Take out the spices and add the scalded raisins, figs, grapes and almonds last.

Maraschino Punch

Take 2 pounds of sugar.
3 pints water.
2 lemons—juice only.
2 oranges—juice only.

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1 pint Maraschino.
6 whites of eggs, whipped.

Mix the sugar, water and juice of punch together; strain, freeze, add the whipped whites and beat up.

Champagne Punch.

Same as Maraschino, substituting Champagne for Maraschino.

Russian Punch.

Take 1 quart Black Tea made as for drinking.
1 pint water.
1 pint Port Wine.
½ pint Brandy.
1½ pounds of sugar.
3 lemons.
Little caramel to color.

Cut the lemons in small slices in a bowl, make a boiling syrup of the sugar and water; pour over and let stand till cold. Add tea, liquor, strain, and then freeze. Keep lemon slices on ice and mix in when frozen.

Roman Punch.

Take 4½ quarts water.
3½ pounds of sugar.
3 pints Jamaica Rum.
6 or 8 lemons.

Grate rinds of lemons and use juice; freeze in the usual manner.

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COFFEE THAT IS GOOD

To make good coffee is apparently not so simple as it may seem, if general results count for anything. The coffee served at some of the best restaurants testifies to this, and even the home-made morning cup of coffee is seldom perfectly satisfactory. A writer in the London Lancet deplores the fact that a good cup of coffee is so seldom found, and declares that there should be no difficulty in making it, and recommends that the simplest way is the best. There is no better stimulant in the morning than a delicious cup of coffee, and there is no better way of preparing it than according to the following recipe: Do not buy the coffee already ground, for it loses its fine flavor more rapidly when in the ground form than when whole. Have a small coffeemill and grind it yourself.

A mixture of two or more kinds of coffee will give the most satisfactory result. Two thirds Java, with one third Mocha, will make a rich, smooth coffee. Now for the recipe: Put one cupful of roasted coffee into a small fryingpan, and stir it over the fire until hot, being careful not to burn it. Grind the coffee rather coarse and put it in a common coffeepot. Beat one egg well, and add three tablespoonfuls of cold water to it. Stir this mixture into the coffee. Pour one quart of boiling water on the coffee, and place the pot on the fire. Stir the coffee until it boils, being careful not to let it boil over; then place on the back of the stove, where it will just bubble, for ten minutes. Pour a little of the coffee into a cup, and return it to the pot. Do this several times. This is to free the nozzle of the particles of coffee and egg which may have lodged there. Place the coffeepot where it will keep warm, but not get so hot that the contents will bubble. After it has stood for five minutes, strain it into a hot coffeepot, and send to the table at once.

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LIQUORS TO SERVE WITH CERTAIN SPECIFIED FOODS

Fashion, taste, and the instincts of the stomach, suggest the following:

Raw oysters — Sauterne, white Burgundies, or hock.

Soup—Sherry or Madeira.

Fish—Claret, Sauterne, or hock.

Roast (*relves*)—Burgundy or champagne, Roman or Kirsch punch.

Second course roast (game and poultry)—Old Champagnes, sparkling Moselles, clarets, red Burgundies, etc.

Entrees—Champagne.

Game and salads—Champagne.

Dessert—No liquors, or perhaps some fine Hungarian wine, or burnt brandy with black coffee.

With lunch in which cheese and rye or other bread, or cereal or starchy products predominate, the thing most used, and which most aids digestion, is beer, ale, porter, or stout.

Beer is not much drawn from the wood now, ex-

cept in very small bars and at country crossroads. It is just as good drawn from the cellar through pipes plated inside with tin; but they must be kept scrupulously clean, and every morning three or four glasses of beer should be drawn off and thrown away. Pipes should be cleansed every week with a strong solution of sal soda and hot water.

In opening still wines the top of the capsule should be cut, leaving the shining metal below to form an ornamental band. Wipe off the top with a napkin, and, if you serve it, pour with the right hand, holding the bottle in the center of the bulge, pressing lightly with the thumb and fingers. This is more graceful than grasping it impetuously by the neck. It is a custom, more in America than elsewhere, for gentlemen to pour out their own liquors, especially if in a party.

In opening Champagne and other effervescent drinks, including malt liquors, cut the band below the cork with the nippers, and the wires will come off easily by a twist of the hand. It will be necessary to use the corkscrew in case of malt liquors not confined by the patent rubber cork, and there is great danger of cutting the left hand in case of breakage, if, as is generally the case, the bottle is grasped by the neck. It should be held firmly with the left hand near the bottom of the bulge, and the cork should be drawn steadily with the right, and without shaking the bottle. There is no danger by this method.

CORDIALS

Kirschwasser, a spirit from black cherries, in great demand throughout Europe, is becoming abundant in the United States, and equal to any in Europe. Kirsch is an excellent digestive and tonic for throat, lungs and entire system; used in sorbets, etc. A punch of kirsch, coffee, sugar and ice-water makes a delicious drink in warm weather.

Benedictine, distilled at Fecamp, Normandy, is a very famous old cordial, originally prepared exclusively by the Benedictine monks, but since the French Revolution it has been made by a secular company. It is known principally as a genitial stimulant.

Chartreuse is a tonic cordial, very palatable, and highly esteemed for its stomachic and antifebrile virtues. It is prepared by the distillation of various aromatic plants, especially nettles, growing in the Alps, carnations, absinthium, and the young buds of the pine tree. There are three kinds, green, yellow, and white.

Maraschino originated with the Italians. For years the Pope sent this delicious liquor to all the grandees of the world. Queen Elizabeth of England was extravagantly fond of it, and, as if to honor it, drank it from a goblet of gold. The basis of Maraschino is black cherries, jasmine, roses, orange flowers, etc., fermented and distilled. It is recommended as an anodyne against nervousness. It is extensively used in the preparation of jellies, sorbets, pastry, etc.

Montana is prepared from the juices of plants, flowers, roots, etc., growing on the highest mountains of America, principally the Rockies and Alleghanies. It is a powerful digestive, suitable for everybody, but principally for the aged and debilitated. It should generally be taken after dinner.

Curacao, dub (sweet) and sec (dry), also triple sec, has for its basis the peel of the young bitter orange growing generally in the island of Curacao, a possession of Holland, off South America. It is a digestive, and is used as a preventive against fever. It is white or green in color.

Anisette is recommended for the cure of flatulency, colic, etc. The aroma and flavor of this delicious, ancient, and popular liquor is obtained from annis seed.

Absinthe (green or white), a bitter beverage used as an appetizer, and bitterly denounced and as warmly praised by different *critiques* the past century. The present method of preparation dates back only sixty years. Formally it was simply an infusion of herbs in white wine. In Normandy and in certain countries around the Alps it is still prepared in that crude way. The distillers of Besancon, Pontarlier, and Couvet hit on the idea of distilling the Absinthe herb (wormwood), adding annis, fennel, and corriander seeds, etc., *ad lib.*, these making an agreeable beverage. Absinthe so made soon had considerable success, which had the usual effect of bringing out the injurious trash made from oils, essences, etc. Absinthe, if properly made, is healthful—a wonderful appetizer and soother of the nerves—if not taken in excess. It is usually taken with half a glass of water to a small wineglass of

Absinthe. The water is allowed to drip on the Absinthe so as to milk or pearl it. Taken pure it has the same properties as peppermint in cases of colic or cramps. To some tastes a cocktail is much improved by the addition of two or three drops of Absinthe.

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SYRUPS, ESSENCES, TINCTURES, ETC.

These preparations consist of ingredients used in the following recipes for making prepared punches, cocktails, etc.

Plain Syrup.

Take 6½ pounds of loaf-sugar.
½ gallon of water.
The white of 1 egg.
Boil until dissolved, and filter through flannel.

Gum Syrup.

Take 14 pounds of loaf-sugar.
1 gallon of water.
Boil together for five minutes, and add water to make up to 2 gallons.

Lemon Syrup.

Take 5 gallons of gum syrup.
4 ounces of tartaric acid.
1 ounce of oil of lemon.
1 pint of alcohol.
Cut the oil of lemon in the alcohol, add the tartaric acid, and mix thoroughly with the syrup.

Essence of Lemon.

Take 1 ounce of oil of lemon.
1 quart of alcohol (95 per cent).
½ pint of water.
1½ ounces of citric acid.
Grind the citric acid to a powder in a porcelain mortar; dissolve it in the water. Then cut the oil of lemon in the alcohol, and add the acid water.

Tincture of Orange Peel.

Take 1 pound of dried orange peel (ground).
1 gallon of spirits (95 percent).
Place them in a closely corked vessel for ten days; strain and bottle for use.

Tincture of Lemon Peel.

Cut into small chips the peel of twelve large lemons; place it in a glass jar, and pour over it one gallon spirits seventy percent; let it stand until the lemon peel has all sunk to the bottom of the liquor; it is then ready for use without either filtering or straining.

Tincture of Cloves.

Take one pound of ground cloves; warm them over a fire until quite hot; put them quickly into a jar, pour on them one gallon ninety-five percent alcohol; cover them air-tight, and let them stand for ten days; draw off into bottles and cork close.

Tincture of Cinnamon.

Place two pounds of ground cinnamon into a jar, with one gallon ninety-five percent alcohol, closely covered; at the end of eight days strain the liquor clear; wash the sediment with one quart proof spirits; strain it; mix the two liquors together, and filter through blotting paper.

Cider Cup.

To a quart o. cider add half a lemon squeezed, three tablespoonfuls of powdered lump sugar, two wine-glasses of pale brandy, a wine-glass of Curacoa, two slices of lemon, with grated nutmeg on the top. Ice well, and serve with borage.

White Special.

(GIN FIZZ.)

Dedicated to the Big 4 R. R.

Made the same as Silver Fizz, but adding about a wine glass of cream. It makes a delicious drink, and is really one of the finest mixed drinks made.

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THE KNICKERBOCKER

Olden worthies who took their cups regularly, and so lived clean and cheerful lives, when they were moved to give up their choice recipes for the public good, described them under the head of "kitchen physic"; for the oldest "Curry," or Cookery Books (the words are synonymous) include under this head both dishes of meats and brewages of drinks. One cup is described as "of mighty power in driving away the cobwebby fogs that dull the brain"; another as "a generous and right excellent cordial, very comforting to the stomach"; and their possession of these good qualities was notably the reason of their appearance at entertainments. Among the most prominent ranks the medicated composition called Hypocras, also styled "Ypocras for Lords," for the making of which various recipes are to be found, one of which we will quote:

"Take of Aqua vitæ (Brandy)	5 oz.
Pepper	2 oz.
Ginger	2 oz.
Cloves	2 oz.
Grains of Paradise	2 oz.
Ambergris	5 grs.
Musk	2 grs.

Infuse these for twenty-four hours, then put a pound of sugar to a quart of red wine or cider, and drop three or four drops of the infusion into it, and it will make it taste richly." This compound was usually given at marriage festivals, when it was introduced at the commencement of the banquet, served hot; for it is said to be of so comforting and generous a nature that the stomach would be at once put into good temper to enjoy the meats provided. Hypocras was also a favorite winter beverage, and we find in an old almanac of 1699 the lines—

"Sack, Hypocras, now, and burnt brandy
Are drinks as warm and good as can be."

SALOON-KEEPING

It is rarely that a saloon-keeper succeeds who is indifferent to the quality of the whiskey sold to customers. No article sold in a saloon is subjected to so much criticism as the whiskey. If the quality is good the customer is sure to be pleased, and a continual patronage is bound to follow. A young, unripe whiskey, no matter what make or brand, is always ruinous to the business of a saloon. Failures are nearly always due to grasping for too much profit on the whiskey served over the bar at ten or twelve and one-half cents a drink, and on which three to six hundred percent profit is wanted.

With each succeeding purchase goods are bought cheaper by the thoughtless saloon-keeper, and with each cheapness the grade deteriorates, patronage grows less and less, and it ends with Mr. Saloon-keeper going out of business a failure.

Bourbon whiskey is ripe between the ages of eight and ten years and continues to improve until much older. Rye whiskey ripens between six and eight years: its taste and flavor is most perfect at these ages; further age is of no benefit to rye whiskey.

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CUPS AND THEIR CUSTOMS

Let your utensils be clean, and your ingredients of first-rate quality, and, unless you have someone very trustworthy and reliable, take the matter in hand yourself; for nothing is so annoying to the host, or so unpalatable to the guests, as a badly compounded cup. In order that the magnitude of this important business may be fully understood and properly estimated, we will transfer some of the excellent aphoristic remarks of the illustrious Billy Dawson (though we have not the least idea who he was), whose illustrisity consisted in being the only man who could brew punch. This is his testimony: "The man who sees, does, or thinks of anything while he is making Punch, may as well look for the Northwest Passage on Mutton Hill. A man can never make good Punch unless he is satisfied, nay, positive, that no man breathing can make better. I can and do make good Punch, because I do nothing else; and this is my way of doing it. I retire to a solitary corner, with my ingredients ready sorted; they are as follows, and I mix them in the order they are here written: Sugar, twelve tolerable lumps; hot water, one pint; lemons, two, the juice and peel; old Jamaica rum, two gills; brandy, one gill; porter or stout, half a gill; arrack, a slight dash. I allow myself five minutes to make a bowl on the foregoing proportions, carefully stirring the mixture as I furnish the ingredients until it actually foams; and then, Kangaroos! how beautiful it is!!". If, however, for convenience, you place the matter in the hands of your domestic, I would advise you to caution her on the importance of the office, and this could not be better effected than by using the words of the witty Dr. King:

"O Peggy, Peggy, when thou go'st to brew,
Consider well what you're about to do;
Be very wise—very sedately think
That what you're going to make is—drink;

Consider who must drink that drink, and then
What 'tis to have the praise of honest men;
Then future ages shall of Peggy tell,
The nymph who spiced the brewages so well."

Respecting the size of the cup no fixed rule can be laid down, because it must mainly depend upon the number who have to partake of it; and be it remembered that, as cups are not intended to be quaffed *ad libitum*, as did Bicias, of whom Cornelius A—— says—

"To Bicias shee it gave, and sayd,
'Drink of this cup of myne.'
He quickly quafte it, and left not
Of licoure any sygne,"—

let *quality* prevail over *quantity*, and try to hit a happy medium between the cup of Nestor, which was so large that a young man could not carry it, and the country half-pint of our own day, which we have heard of as being so small that a string has to be tied to it to prevent it slipping down with the cider.

In order to appreciate the delicacy of a well-compounded cup, we would venture to suggest this laconic rule, "When you drink—think." Many a good bottle has passed the first round, in the midst of conversation, without its merits being discovered. For Claret Cup see page 8.

RECIPE FOR A HUNTING FLASK

As to the best compound for a hunting-flask it will seldom be found that any two men perfectly agree; yet, as a rule, the man who carries the largest, and is most liberal with it to his friends, will be generally esteemed the best concocter. Some there are who prefer to all others a flask of gin into which a dozen cloves have been inserted, while others, younger in age and more fantastic in taste, swear by equal parts of gin and noyeau, or of sherry and maraschino. For our own part we must admit a strong predilection for a pull at a flask containing a well-made cold punch or a dry curacoa. Then again, if we take the opinion of our huntsman, who (of course) is a *spicy* fellow, and ought to be up in such matters, he recommends a piece of dry ginger always kept in the waistcoat pocket, and does not care a *fig* for anything else. So much for difference of taste; but as we have promised a recipe, the one we venture to insert is specially dedicated to the lovers of usquebaugh, or "the crathur." It was a favorite of no less a man than Robert Burns, and one we believe not generally known; we therefore hope it will find favor with our readers, as a wind-up to our brewings.

RECIPE.

To a quart of whiskey add the rinds of two lemons, an ounce of bruised ginger, and a pound of ripe white currants stripped from their stalks. Put these ingredients into a covered vessel and let them stand for a few days, then strain carefully, and add one pound of powdered loaf sugar. This may be bottled two days after the sugar has been added.

THE MODEL BARTENDER

He should be a man of good character, straight personal habits, good temper, cheerful, obliging, wide-awake, quick, graceful, attentive, sympathetic, yet too smart to be "worked," neither grum nor too talkative, of neat appearance and well dressed He should study the tastes of the patrons. For instance, in mixing a cocktail most clerks make the mistake of putting in too much bitters, in which case the drink is spoiled, or rather, is unpalatable to the customer. Most men like but very little bitters. You should, in order to become proficient and popular, study all the points in the mixing of all drinks. There can be too much syrup or sugar, lemon juice or other ingredient used, in the same way as too much bitters in a cocktail. This is a profession that every man can not master. There are men who would not make a first-class bar-clerk in a lifetime. A clerk should not encourage "hangers-on," loungers, or men under the influence of drink. In fact, he should never sell or give to a man in his cups, for this feature casts the greatest odium on our business, which could be made as legitimate as any if in the hands of proper persons.

PREPARATION FOR CUSTOMERS

The first thing to be done in the morning upon opening a saloon is to look after ventilation. There is generally a very odious smell about a place that has been tightly closed during the night, and it is as unwholesome as it is disagreeable. It should be gotten rid of as soon as possible. See that you have enough fine ice prepared to serve your morning customers with drinks, and if the man on watch the night before has failed to fill his bottles, you must perform this duty at once, and place them on ice so that your customers may not have to use warm liquors. You must keep filling them up all day to supply the drain on them, and to avoid serving warm liquors. Polish up your glasses between drinks, and always be ready for customers. See to it that the place is neat and tidy; the window-panes, showcases and nickel-plating clear as crystal, and bright as new minted coins; the linen towels white as snow; the lunch fresh and inviting. A progressive clerk, and the proprieter too, for that matter, will visit other places to see what laudable innovations are being made, what new inducements are being offered. Make your own domains correspondingly or surpassingly attractive, and give the boys a right royal welcome.

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DONT'S FOR YOUNG BARTENDERS

Don't bring yourself into prominence before a crowd at the bar. Be polite and approachable, but let them advance to you.

Don't join in any conversation, but if it is general you may seem interested.

Don't volunteer any opinions unless your patrons express a desire, or at least a willingness to hear you.

Don't express your sentiments at all if at variance with the majority, unless very important interests are at stake.

Don't be too positive about things. You may be in error.

Don't look fiercely at people, or talk loud and harshly, but cultivate a smiling countenance and quiet, but firm tone of speech.

Don't occupy too much space, but give your colleagues behind the bar a chance.

Don't fail to put things in their places, so that you and your coworkers will know where they are when you want them.

Don't fail to get pay for all drinks.

Don't be in too great a hurry to find out what a party of gentlemen want as they approach the bar. Don't let them feel that you begrudge the space they occupy while they talk. Sometimes placing glasses of water before them will break the ice on the subject.

Don't use a wet glass if there is a dry one to be had.

Don't forget to serve your effervescent drinks last in waiting on a party.

Don't overcharge, and don't make short change; be exact and honest as a banker.

Don't use profane language, and do not talk your customers to death.

Don't drink your own liquor; it is bad policy and is liable to make you "how come you so?"

Don't fail to mind your own business, and go to bed sober.

More liquors in volume 6

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